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Remedial Investigation/ Feasibility Study

National Smelting of New Jersey Site Pedricktown, New Jersey

NL Industries
Hightstown, New Jersey

May 1987



O'BRIEN & GERE

WORK PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

NATIONAL SMELTING OF NEW JERSEY SITE

PEDRICKTOWN, NEW JERSEY

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

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SECTION 1 - STUDY AREA

1.01 Regional Description

The secondary lead smelting facility formerly owned by NL Industries, Inc. and owned by National Smelting of New Jersey, Inc. (NSNJ) is located in Oldman's Township, Salem County, New Jersey. Figure 1 presents a location map for the site.

The topography of the region that includes the site is flat to gently rolling land which slopes to the north. The site is approximately ten feet above sea level. The Delaware River lies approximately 1.5 miles to the northwest of the site.

The regional geology is characterized by surficial deposits belonging to the Cape May formation. These deposits consist of fine to medium sand, which is occasionally coarse grained. The deposits extend to a maximum depth of approximately thirty feet and typically yield limited volumes of water. Dense red and gray clays belonging to the Raritan formation separates the surficial formation from the first confined aquifer, a sand unit of the Raritan-Magothy formation. A second clay layer separates the first confined aquifer from the second confined layer. The depth to bedrock may be about three hundred feet. The above information is detailed in Geraghty & Miller, Inc.'s report entitled "Hydrogeologic Study and Design of Groundwater Abatement System at NL Industries, Inc., Pedricktown, New Jersey Plant Site" (May, 1983).

1.02 Oldman's Township

Oldman's township is located in the northern portion of Salem County. It is bounded on the north and west by the Delaware River, by Oldman's Creek and Gloucester County on the north and east, and Upper Penns Neck Township on the south. The site is located along Penns Grove-Pedricktown Road in Pedricktown as shown in Figure 2.

The site is part of an area zoned for development as an industrial park and includes operations of the following major corporate entities: Airco, B.F. Goodrich, Browning-Ferris Industries and Exxon, Tomah Division. It has been reported that some of the industries may have addressed environmental concerns on their property.

1.03 NSNJ Property

The site includes the following parcels of property as presented in Figure 2:

- a. Thirty acres of land southeast of the Pennsylvania-Reading Seashore Lines railroad tracks that include Block 37, Lot 2 (i.e., the "plant area") that includes the former secondary lead smelter.

- b. Sixteen acres of land northwest of the Pennsylvania-Reading Seashore Lines railroad tracks that include Block 39, Lots 17 and 21 (i.e., the "landfill area") that incorporates a closed landfill.

SECTION 2 - SITE HISTORY

2.01 Site Development

The Pedricktown secondary lead smelter was constructed in 1971-2. The smelter originally made use of a blast furnace and a reverberatory furnace for smelting. A sweater furnace was also on site for melting of elemental lead scrap. The Pedricktown facility was upgraded to incorporate systems that would do the following:

- a. Take a tractor-trailer loaded with scrap batteries and dump the scrap batteries into an acid brick lined bin by inclining the tractor trailer to a sixty degree angle on a hydraulic ramp.
- b. Crush the batteries.
- c. Separate the plastic/rubber case materials, metallic lead, and lead compounds for recycling.
- d. Smelt lead bearing materials (i.e., a rotary kiln) with minimal emissions of sulfur oxides.

A detailed drawing of the plant area showing major pieces of equipment and production areas is presented in Figure 3.

The Pedricktown refinery was built in 1972. The facility consisted of twelve refining kettles and a one hundred mold Wirtz casting machine. The refinery produced soft lead and antimonial lead from the furnace product.

2.02 Rotary Kiln Installation and Process

Secondary lead smelting at the Pedricktown facility originally was accomplished using a blast furnace and a reverberatory furnace. These were taken out of service when a rotary kiln was installed in 1978. The rotary kiln employed at NL Industries' Pedricktown facility is a 177 foot long, 10 foot diameter converted cement kiln. A thirty-five million BTU oil burner fires the kiln at the discharge end. The rotary kiln is located east of the slag yard and slag crusher building on the west side of the plant area.

Raw materials fed into the kiln consisted of soda ash, cast iron chips, coke and lead bearing feed. All raw materials were fed to the rotary kiln by a 150 foot long completely enclosed belt conveyor. The material was transferred from the top of the conveyor belt and discharged into the rotary kiln by either an angled feed chute or a feed screw. The device used depended on the type of material entering

the kiln. The gas stream from the rotary kiln was sent through an eighteen cell baghouse for particulate removal.

The slag and metal collected at the discharge end of the rotary kiln. Slag continually overflowed a corebell weir at the discharge end of the kiln and was deposited in slag pots via chutes. Lead was taken periodically from the kiln by stopping the kiln, breaking the tap hole open and rotating the kiln until the tap hole allowed lead to flow down a refractory lined chute into molds. The slag pots and lead button molds were placed on the cable-drawn trains. Pellet/middlings, plant scrap, and 3:1 grid metal/pellets were the three basic charges to the kiln. The kiln output varied depending on the charge used.

A more detailed account of rotary kiln operation is provided in "Rotary Kiln Smelting Of Secondary Lead", by R.C. Egan, M.V. Rao and K.D. Libsch (Reprinted from: Lead-Zinc-Tin '80, edited by John M. Cigan, Thomas S. Mackey and Thomas J. O'Keefe, Proceedings of a World Symposium on Metallurgy and Environmental Control sponsored by the TMS-AIME Lead, Zinc and Tin Committee at the 109th AIME Annual Meeting, February 24-28, 1980, Las Vegas, Nevada).

2.03 Landfill Development and Closure

NL Industries, Inc. (NL) established a permitted hazardous waste landfill on its Pedricktown facility's property. Figure 2 shows the location of the landfill, which consists of two phases, Landfill Phase A and Landfill Phase B. Landfill Phase A contains process wastes (blast furnace and kiln slag) from the facility, while Landfill Phase B also contains hard rubber case material and lead contaminated soils that were excavated from the facility's grounds. Details on landfill design and closure are presented as Exhibit A.

2.04 1982-83 Cleanup and Property Transfer to NSNJ

NL Industries, Inc. (NL) terminated lead production using the rotary kiln on May 27, 1982. On October 6, 1982, NL signed an Administrative Consent Order (ACO) with the New Jersey Department of Environmental Protection (NJDEP) whereby NL agreed to undertake a variety of activities in order to address environmental conditions at the site. The activities under the ACO involved the following:

- ° removal of specific marsh soils,
- ° prevention of runoff of all surface water from paved areas,

- ° cleaning of the paved areas shown in Figure 5,
- ° retention of a consulting firm (Roy F. Weston, Inc.) to prepare closure and post-closure plans that would comply with 40 CFR 265,
- ° installation of two deep groundwater monitoring wells,
- ° sampling on a quarterly basis of groundwater monitoring wells, and
- ° retention of consulting firms to design a groundwater abatement system (Geraghty and Miller, Inc.) and installation and testing of the groundwater abatement system (Moretrench American Corp. and Ground Water Technology, Inc.).

NSNJ exhibited interest in purchasing and operating the Pedricktown facility. National Smelting and Refining Co., Inc. (NSR) was a part owner in NSNJ. NL, NSNJ, NSR and NJDEP entered into an Amended Administrative Consent Order (AACO) on February 10, 1983 to delineate and distribute the environmental obligations specified in the ACO. The AACO amended the ACO, transferring to NSNJ environmental obligations which were originally the responsibility of NL under the ACO. NSNJ agreed to comply with ongoing environmental requirements, while NL still retained some of its original obligations. An agreement for sale of the Pedricktown lead smelting facility between NL and NSNJ was dated February 24, 1983. Prior to February 8, 1983 NL had completed all cleanup measures directed at the plant area. NL prepared photographic documentation of the work that was completed.

The NJDEP acknowledged NL's completion of specified items under the ACO in the preamble to the AACO.

2.05 NSNJ Operations

NSNJ took possession of the Pedricktown property on February 24, 1983. NSNJ then operated the facility until January 20, 1984. NSNJ commenced rotary kiln smelting on May 27, 1983. NSNJ filed for bankruptcy under Chapters 11 and 7 on March 5th and 27th 1984 respectively.

During the operation of the Pedricktown facility by NSNJ, NSNJ allowed slag waste from their processing of lead, along with other bulk, drummed and/or containerized waste materials and raw materials (including ore concentrates, fluxes and reagents) to accumulate in non-enclosed areas that were exposed to the elements. Following bankruptcy filing, the National Bank of Georgia, trustee for the site bond holders, maintained environmental personnel at the site for landfill maintenance purposes until June 15, 1984. NL voluntarily entered the site on June 18, 1984 to pump landfill leachate which had accumulated in the leachate sumps, and to maintain landfill cover materials.

SECTION 3 - EXISTING CONDITIONS

3.01 Existing Facilities and Utilities

The following facilities and utilities are now present at the Pedricktown smelting facility:

- a. Battery yard.
 - i. battery hopper and breaker (shredder)
 - ii. acid handling facilities
 - iii. spent battery storage
- b. Processing equipment for lead compounds to render them suitable for furnace feed.
 - i. Trommel
 - ii. Bucketwheel
 - iii. Split Screen
 - iv. Spiral Classifier
 - v. Libra Screen
 - vi. Vacuum Filter
 - vii. Dryer (pelletizer)
- c. Rotary Kiln furnace and related equipment (buffer storage buildings, feed conveyor, coke and soda ash silos, iron hopper, slag and lead trains, slag storage bins, and slag crusher).
- d. "Sweater" furnace to melt elemental lead scrap.
- e. Refining Kettles.
- f. Old Blast Furnace.
- g. Casting lines for crude and purified ingots.
- h. Emission control equipment consisting of the following:
 - i. "Fuchs "chamber
 - ii. "Balloon duct" for rotary kiln
 - iii. "Metallurgical baghouse" for rotary kiln
 - iv. "Sanitary baghouse and two cyclones" for refining building
 - v. Two "sweater furnace baghouses" and a cyclone
 - vi. "Slag crusher baghouse"
 - vii. "Toy baghouses"
 - viii. "Ducon wet scrubber"
 - ix. Related ductwork and hoods

Currently there is no electrical power supplied to the production areas. Electrical power is supplied to maintain the landfill.

3.02 Existing Material Storage

The following material storage facilities currently exist at the Pedricktown smelting facility:

- a. A large receiving yard (acid brick lined) which contains various lead bearing materials and waste materials.
- b. A warehouse which contains a variety of drummed materials. Two silos containing bulk soda ash and petroleum coke. The drummed or otherwise containerized raw materials which are located in the warehouse consist of: caustic soda, sodium nitrate, red phosphorus, sulfur, lime, saw dust, charcoal, caustic potash, metallic cadmium, selenium, copper, arsenic, bismuth, calcium, calcium/aluminum, tin/aluminum, sodium, antimony, tin, zinc and aluminum.
- c. An inner yard which contains various lead bearing raw and waste materials. The inner yard was intended for the temporary storage of crude metallic lead "buttons" from the kiln and sweater furnaces.
- d. Bins containing various lead bearing and waste materials. The bins were intended for the storage of "dross", iron, coke and slag.
- e. An acid pit and two acid tanks.
- f. A thickener pit and tank.
- g. Wastewater tanks.
- h. Effluent tank.
- i. Wash water tank.

3.03 Current Landfill Maintenance Activities and Facilities

Presently, the activities associated with the landfill include cover maintenance (e.g. mowing, visual inspections) and leachate management (e.g. leachate monitoring and pumping and coordination of leachate hauling).

Facilities presently found at the landfill consist of the closed hazardous waste landfill, the landfill office and maintenance facilities and the diked leachate storage tank.

SECTION 4 - PRELIMINARY REMEDIAL TECHNOLOGIES

Prior to starting any investigations, conditions at the site will be addressed relative to risks associated with the no-action alternative. Should the projected risk be such that some action is justified, the appropriate actions will be evaluated.

This exercise will also identify those categories of remedial technologies that are potentially applicable to remedy adverse environmental conditions at the site. In this way, the Remedial Investigation can be tailored to ensure that the field investigation will generate sufficient data to properly evaluate the technologies and alternatives in the Feasibility Study.

4.01 Interim Remedial Measures

The possible use of an interim remedial measure will be based on the evaluation of risks associated with the no action alternative. Interim remedial measures considered for the Pedricktown facility consist of a variety of alternatives designed to restrict transportation of material from the site in the near term. For example, existing storage structures could be utilized for materials that should be kept out of the elements. In addition, covers might also be used to protect bulk materials from rain and wind that could transfer the material from the site into surrounding areas. The evaluation of interim remedial measures and recommendations associated with these measures will be presented in the Draft Remedial Investigation Report.

4.02 Recycle/Reuse Assessment

The possibility of recycling and/or reusing materials found at the Pedricktown smelting facility will be considered as a preliminary remedial technology. Many of the materials accumulated on the site are raw or intermediate materials. Consequently, recycling and/or reusing the materials is expected to play a major role in site remediation. Consideration will be given to methods which would effectively recycle or reuse materials found at the Pedricktown site.

4.03 On-Site Remedial Approaches

Several on-site remedial approaches exist for the Pedricktown smelting facility. These include the excavation of bulk materials and contaminated soils. The excavated material could be placed in containers for storage on-site, they could be solidified on-site, or they could be landfilled on-site. Demolition of selected structures contained on the site could also be done. Groundwater controls such as pumping and treatment or impermeable barrier walls could be considered in the case of contaminated groundwaters. At the present time, a ground water abatement system exists at the site, although no method of treatment has been designed and constructed. In situ fixation of soils could also be considered.

4.04 Off-Site Remedial Approaches

As with on-site remedial approaches, off-site remedial approaches to be considered include off-site treatment and disposal of excavated bulk materials and soils. The excavated materials could be landfilled off-site. Fixation/solidification techniques may be used prior to off-site land disposal. Recycling and reuse of on-site materials could also be considered.

SECTION 5 - REMEDIAL INVESTIGATION/FEASIBILITY STUDY OBJECTIVES

The Remedial Investigation/Feasibility Study is designed to accomplish the following goals:

- A. Identify the environmental conditions at the NSNJ property and surrounding properties affected by the Site.
- B. Evaluate the impacts that any past, present or future release or migration of contaminant may have on public health or the environment.
- C. Develop, screen, and evaluate potential response actions in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Section 300.68.

Table 11 presents the anticipated schedule for the Remedial Investigation/Feasibility Study.

SECTION 6 - REMEDIAL INVESTIGATION WORK PLAN

6.01 Site Investigations

Several studies have been conducted from 1980 through 1986 involving soils, surface water, and ground water at the Pedricktown site. The purpose of this section is to present existing data and outline what activities will be conducted as part of the Remedial Investigation. It should be noted that the NJDEP has conducted several studies for which data are not currently available. The scope of work presented below may be reduced upon review of the NJDEP data.

6.01.1 Soils Investigation

Previous Studies:

A soil sampling program was completed by NL in early 1981 which was conducted in response to concerns raised by the NJDEP. The samples were obtained in late 1980. Sample locations from this study are shown in Figure 6. Total lead analysis was run for all samples, with the sample depths analyzed varying between sample locations. Samples were obtained from depths of 0"-2", 5"-7" and 11"-13". The results of these analyses are presented in Table 1.

Sediment samples were also obtained from marsh areas in late 1980 as part of the overall site soil sampling program. Sediment sample locations are presented in Figure 7. Total lead analysis was conducted on all samples, with sample depth analyzed varying between sample locations. Sample depths and corresponding analytical results are presented in Table 2.

These analyses were the basis for the excavation of contaminated plant soils and marsh sediments which took place prior to the sale of the facility. As mentioned in Section 2.4, areas and depths of excavation are presented in Figure 4. The excavated soils and sediments were placed in the Phase B landfill located on-site, which was subsequently closed in accordance with an approved closure plan.

Develop Sampling Grid:

A sampling grid has been developed to locate surface soil sampling points. By utilizing a grid pattern, the areal distribution of contaminants can be readily identified. A regular grid pattern also allows the use of interpolation techniques to identify concentrations of contaminants between sampling points.

Studies have indicated that surface soil lead concentrations decrease exponentially with distance from the source such that concentrations of lead less than 1000 ppm would typically be present at distances greater than approximately 1200 feet from a source such as a secondary lead smelter (Roberts, TM, T.C. Hutchinson, et al. 1974. "Lead Contamination Around Secondary Smelters: Estimation of Dispersal and Accumulation by Humans." Science 186:1120-22.). Lead concentration in surface soils would be expected to be highest and most variable near the source (i.e., the site). As the distance from the source increases, the lead concentration in the surface soil would be expected to decrease and less variation in the lead concentrations would also be observed. Therefore, the surface soil sampling grid will consist of a finer grid pattern on the site and a progressively coarser pattern as the distance from the site increases.

A regularly spaced triangular grid pattern will be utilized in determining on and off-site soil sampling points. A triangular grid pattern is more efficient relative to sample area coverage than is a rectangular grid pattern (Parkhurst, D.F., "Optimal Sampling Geometry for Hazardous Waste Sites", Environmental Science and Technology, 1984, 18, 521-523). Two hundred foot triangles will be utilized within the property lines of the facility. Outside of the facility boundaries, two sets of four hundred foot triangles will be used, followed by a single set of eight hundred foot triangles. This will provide for characterization of surface soil concentrations at distances from the facility boundaries of 1600 to 2000 feet, which represents distances of approximately 2000 to 2500 feet from the source. The surface soil sampling locations are presented in Figure 2. Supplemental sampling of the marsh area is addressed in Section 6.01.3.

Brief Description of Sampling Protocol:

Each grid point sample will be composed of four discrete samples collected from around the grid point and composited. A three meter diameter circle will be measured around the grid point and samples will be taken from the northernmost point on the circle, the southernmost point, the easternmost

point and the westernmost point and then composited. In the event that a three meter circle cannot be utilized around the grid point, four discrete samples will be collected along a line extending approximately twenty feet from the grid point and then composited. Composite samples will be collected to represent strata of 0" to 3", 3" to 6", 6" to 12", and 12" to 18" below grade. Soil samples from the secure landfill cover shall be to a depth of 18 inches or to the clay layer, whichever is least. All surface soil samples will be collected by hand driven 3/4" Lexan® tubes. Exact sample locations will be determined in the field. Every effort will be made to avoid collecting soil samples that are less than twenty feet from painted surfaces and/or under or immediately adjacent to trees, shrubs and/or structures. Collection sites will also be located as far as possible from vehicle activity such as streets, driveways, parking areas and automobile repair areas. Detailed sampling protocols will be included in the Project Sampling Plan which will be part of the Site Operations Plan.

Analytical Parameters:

Soil samples from 0" to 3" and 3" to 6" below grade will be analyzed for total lead. Approximately 10% of the soil samples will be analyzed for supplemental metals consisting of antimony, arsenic, cadmium, copper, chromium, lead, selenium, tin, and zinc. Approximately 75% of the samples to be tested for the supplemental metals will be selected from on-site locations. If the 3" to 6" below grade sample demonstrates contamination then the two deeper samples at that location will be digested and analyzed for only those parameters above background. Examination of past data suggests considerable variance for lead concentration in soil. For the purpose of this investigation deeper samples will be analyzed if the 3" to 6" strata has a total lead concentration (dry weight basis) of greater than 200 ppm. The analytical program for soil samples is presented in Table 3.

6.01.2 Stored Materials Investigation

Previous Studies:

Previous studies regarding bulk and containerized solids are limited to analyses of rotary furnace slag. Analyses have previously been conducted on the landfill leachate. This leachate data is presented in Exhibit D.

Bulk and Containerized Solids Preliminary Inventory:

A large quantity of bulk and containerized materials exist at NSNJ's Pedricktown facility. The bulk and containerized solids consist of: slag, equipment residue and containerized solids (i.e., baghouse dust, miscellaneous process waste and raw materials). These materials are present in the plant area and warehouse. An inventory of these materials will be conducted to quantify the amounts of these materials present at the facility and to identify their locations on the site. Mr. Stephen W. Holt, the individual who was responsible for the facility's environmental activities from March 1979 to February 1983, will assist in identifying materials during the inventory based on his experience at the site.

Characterization Objectives:

Each group of bulk and containerized materials identified at the facility will be sampled, with the exception of labeled containerized raw material and specifically identifiable bulk materials (i.e. new refractory brick, used bags, pellets, etc.). Analyses will be run on the samples of unidentified materials and identified materials to classify them as hazardous or non-hazardous. Knowledge of the composition and characteristics of identified materials may be utilized in lieu of analysis. The objectives of analyzing identified materials which may be hazardous is to determine appropriate management approaches. For example, lead bearing ceramic industry waste would be analyzed for total lead to determine feasibility of recycle operations. Only total lead analysis will be conducted on the equipment residue samples, since they are essentially raw and intermediate materials and will likely be recycled. The characterization of the materials as hazardous or non-hazardous will determine the method of management for each type of material.

Brief Description of Sampling Protocol:

Samples will be taken from bulk and containerized raw materials identified, with the exception of labeled containerized raw materials. Based on the available estimates the following samples will be collected:

- ° three composite slag samples one each from the iron and coke bins, battery bins, and slag bins,

- ° ten equipment residue samples, and
- ° twenty-five containerized solids samples.

The slag samples will be collected manually using geologic tools or other equipment as necessary. Samples from the other areas will be collected with shovels or other appropriate tools. Drum and container sampling will be accomplished by using a sampling trier or other appropriate equipment. The Sampling Plan will present details of how this will be accomplished.

Analytical Parameters:

Total lead analysis will be conducted on all bulk and containerized solids samples. The EP toxicity test for all metals listed in 40 CFR 261.24 will be run on all slag samples. In addition, metal analyses for the following metals: antimony, arsenic, cadmium, chromium, copper, selenium, tin, and zinc will be conducted on unknown bulk and containerized solids samples. The analytical program for bulk and containerized solid materials is presented in Table 3.

Contained Liquid:

The liquid volume of stormwater and wastewater contained in the following areas will be estimated: a pond on asphalt pavement at the east side of the plant area, a pond on concrete pavement in the center of the plant area, an acid pit, two acid tanks, a thickener pit, a thickener tank, wastewater tanks, an effluent tank, leachate sumps for landfill Phases A and B, primary and secondary and a washwater tank. These facilities are identified on the plant area map presented as Figure 3. Miscellaneous accumulations (less than 5000 gallons) exclusive of drums or tanks will be pumped to one of the above areas prior to any inventories and sampling.

Brief Description of Sampling Protocol:

One sample will be taken from each of the storage areas/facilities noted previously as holding storm or wastewater. If the liquid depth at the sample location is greater than three feet, a depth compositing technique will be used to obtain the samples. Otherwise, grab sampling techniques will be utilized to obtain the samples.

Rainwater accumulations in uncovered drums will be pumped to a storage container and sampled as a composite. The uncovered drums will be covered after pumping off the accumulated rainwater. All unidentified covered drums containing liquids will be sampled.

Analytical Parameters:

Each sample taken will be analyzed for pH, lead, and total organic carbon (TOC). Leachate, if present, from primary and secondary sumps of landfill Phases A and B will also be analyzed for Total Organic Carbon, Total Organic Halogens, Gross Alpha and Beta Radiation, cyanides, and priority pollutant metals. If Total Organic Carbon or Total Organic Halogen results indicate a potential problem then priority pollutant organic analyses will be conducted. Analytical results from leachate samples will be compared to those for hydraulically upgradient and downgradient ground water monitoring wells in the vicinity of the landfill to determine whether migration of contaminants from the landfill is occurring.

6.01.3 Surface Water and Marsh Investigation

Adjacent Surface Waters

As indicated on the topographic map and site map presented in Figures 1 and 2, respectively, a stream courses along the site's western boundary. The stream, referred to as the West Stream, receives most of the stormwater runoff from the site and eventually discharges into the Delaware River.

A marshy area which intermittently holds surface water is present on the site as shown in Figure 2. One portion of the marshy area is south of the railroad tracks (i.e., the "south marsh") and one portion is north of the railroad tracks (i.e., the "north marsh"). The north marsh and south marsh are hydraulically connected by a culvert which passes beneath the railroad tracks. Stormwater from several sections of the plant area runs off into the south marsh and through the culvert into the north marsh. An intermittent stream runs from the north marsh to the West Stream, so when sufficient surface water is in the north marsh, it discharges into the West Stream and eventually into the Delaware River.

A second stream, located on Figure 2, runs approximately 1000 feet east of and parallel to the site's eastern property boundary. This stream,

referred to as the East Stream, receives stormwater runoff from surrounding properties. During periods of high flow, the East Stream reportedly backs up into an intermittent channel which discharges into the south marsh.

Previous Studies:

Water samples from the marsh area were collected at various times during the period from 1981 through 1983 and analyzed for a variety of parameters. The analytical results for these samples are presented in Table 5. The data indicate that several parameters were detected in levels exceeding Water Quality Criteria. No previous studies of the East or West Streams are known to have occurred.

Sediment samples collected from the marsh area during 1980 were analyzed for lead to determine limits of excavation. A brief description of the results is presented in Section 6.01.1 and Table 2.

Sampling Rationale:

In order to characterize surface water quality, particularly relative to site impacts on surface water quality, samples should be obtained upgradient of the site, on or adjacent to the site, and downgradient of the site. The objective would be to sample during both high and low flow conditions to account for water quality variations with stream flow.

To evaluate the potential for sediment transport, sediment samples will be collected at eight locations in the marsh area and at each surface water sampling location.

Approximate Sample Locations and Frequency:

Surface water and sediment samples will be obtained at several locations. Approximate sample locations are presented on Figure 8.

Regarding the West Stream, samples will be obtained from each of the following locations:

- upstream of the facility's western property boundary
- immediately downstream of the facility's western property boundary
- approximately 800 feet downstream of the facility's western property boundary.

The samples from the East Stream are located such that samples will be obtained from each of the following areas:

- immediately upstream of the railroad track
- approximately 1000 feet downstream of the railroad track.

Surface water samples will be collected twice during the course of the Remedial Investigation to account for varying environmental conditions.

Approximate locations for the eight sediment samples from the marsh are presented on Figure 2.

Brief Description of Sampling Protocol:

Surface water samples will be obtained using grab sampling techniques in the approximate middle of the channel approximately one inch below the surface, in such a way so as to avoid suspension of sediments.

Sediment samples will be collected using a coring device to represent the strata from 0" to 1" below the top of sediment. Specific sampling procedures will be detailed in the Sampling Plan.

Analytical Parameters:

All surface water samples will be analyzed for pH and total lead. In addition, the sample from the location immediately upstream of the intermittent stream's discharge into the west stream will be analyzed for the following total metals: antimony, arsenic, cadmium, chromium, copper, selenium, tin, and zinc.

Sediment samples will all be analyzed for total lead. Sediment collected immediately upstream of the intermittent stream's discharge into the West Stream will be analyzed for the same metals listed for that surface water sample. The analytical program for surface water samples is presented in Table 3.

6.01.4 Hydrogeologic Investigation

Previous hydrogeologic studies have demonstrated the existence of three water bearing units beneath the site. The three units consist of: the water table aquifer, first confined aquifer, and second confined aquifer. Each strata

is described separately below with a review of previous studies and proposed additional activities. A summary of ground water data generated since 1981 for both the on-site wells and nearby private wells is presented in Tables 6 through 9. Exhibit E presents ground water level measurements obtained during previous studies.

Water Table Aquifer

Previous Studies:

The water table aquifer directly beneath the Pedricktown facility is of the Cape May Formation and is composed mainly of fine to medium sands with interspersions of silty clay lenses. The saturated thickness of the water table aquifer ranges from fifteen to thirty-five feet. Previous studies conducted by Geraghty & Miller, Inc. (1983) indicate ground water flow direction is generally towards the west and north at an average rate of approximately one foot/day.

A total of thirty-nine wells have been installed at the Pedricktown facility (see Figure 8). A Monitoring Well Data Summary is shown in Tables 6, 7 and 8. Thirty-four of these screen the water table aquifer, including twelve pairs of nested wells which screen the upper and lower section of the aquifer. The remaining ten water table aquifer wells screen the water table at various depths with screen lengths ranging from six to thirty feet.

Boring logs indicate that a non-continuous silt/clay layer exists in the southeast section of the site. The silt/clay layer is approximately twenty feet thick as observed in borings RD, HD and CR2 and ranges in depth between five and twenty feet below grade. This layer apparently pinches out somewhere between boring RD and boring BR to the west and somewhere between boring ID and boring 10 to the north. The extent of this layer to the south and east is unknown. Water level elevations in well nests I and R, installed in this area, indicate that perched ground water conditions exist above the silty/clay layer. Previous studies have identified a significant ground water divide in the area of this silty clay layer. While this divide clearly exists for the shallow perched portion of the aquifer, the existence of a divide in the water table aquifer below the silty clay is not defined.

An area of the water table aquifer where data on ground water elevations and geology is limited is the northeast corner of the facility. Subsurface work in this area will provide helpful information on ground water flow direction, contaminant migration, and geologic conditions.

Additional Hydrogeologic Studies:

The area to the northeast of the plant proper will require additional monitoring wells to determine the extent of contamination and the direction of ground water flow. A monitoring well will be installed in the northeast area. This well will be installed screening the lower water table aquifer. The well will be installed using auger drilling techniques in accordance with the Overburden Monitoring Well Installation Protocol, to be provided in the Site Operations Plan, and will conform with NJDEP requirements for monitoring well installation. Split-spoon samples will be collected at a minimum of five foot intervals or at changes in stratigraphy. Split spoon samples will be collected in accordance with ASTM Method D-1586-67. The proposed well location is shown on Figure 8, however exact placement will be determined in the field. The well will also be gamma logged following installation.

A site wide ground water sampling program will be instituted following the installation of the above well. Two sampling events are scheduled at a two month interval. These two events will provide the supplemental data base for the evaluation of existing conditions as well as temporal trends.

The following deep water table monitoring and observation wells will be sampled: BR, CR2, 2R2, 3R, 4R, 5R, HD, ID, JD, KD, LD, MD, ND, OD, PD, QD, RD, SD, and the proposed well. Wells will be sampled in accordance with the Ground Water Sampling Protocol, to be provided in the Sampling Plan, and will conform to NJDEP procedures for ground water sampling. The sampling procedure used will include evacuation of a minimum of three well volumes prior to sampling to minimize contact time between ground water and well casing. All deep water table aquifer wells scheduled for sampling will be analyzed for the following parameters:

- ° Antimony*
- ° Arsenic*
- ° Cadmium*
- ° Chromium*
- ° Copper*
- ° Lead*
- ° Seleniun*
- ° pH (field)
- ° Conductivity (field)
- ° Chlorides
- ° Sulfate
- ° Gross Alpha & Beta*
- ° Total Organic Carbon (TOC)
- ° Total Organic Halogen (TOH)

* Filterable (soluble fraction)/total⁽¹⁾

The following shallow water table aquifer observation wells will be sampled during the first round of sampling only: HS, KS, MS, NS, and SS. The samples will be analyzed for the same parameters as the deep water table wells.

The additional parameters of filterable/total⁽¹⁾ priority pollutant metals and total cyanides will be analyzed on samples from Wells ID, SD and QD in the first round of sampling. These wells were chosen since they appear to be the most impacted wells with respect to ground water quality. Any of the parameters which are identified in any of these three samples within 75% of the Primary Drinking Water Standard will be added to all well samples in subsequent sampling and analysis.

Three wells will be selected based on round one sample results for specific organic hazardous substances analyses during round two. Specific organic substances are defined as priority pollutant organic chemicals.

Ground water samples will be collected and analyzed for filtered gross alpha and gross beta-particle activity during the first round of sampling. If alpha activity levels are found to exceed 5 pCi/L, or are above the area background activity, whichever is higher, then samples will be collected the second round of sampling and analyzed for radium-226. If radium-226 activity exceeds 3 pCi/L, then the sample will be analyzed for radium-228. If gross beta particle activity exceeds 50 pCi/L during the first round of sampling, samples will be collected the second round and analyzed for the man-made radionuclides.⁽¹⁾

Plant and landfill areas will be surveyed with a radiological survey meter to identify possible sources of radiation. The monitoring protocol will be specified in the Site Operations Plan.

If the analytical results of the initial sampling event reveal non-detectable levels of any of the specified parameters in any well, that specific parameter will be deleted from future analysis for that well.

(1) Determination of the utilization of filterable vs. total metals results and specific radiologic analyses is subject to final clarification and agreement within the Site Operations Plan specifications. The MCLs which would be expected to be utilized are based on filterable analysis, except where it pertains to surface water and private water supply wells along State Route No. 130.

Ground water elevation data will be collected bi-monthly from each well screening the water table aquifer, for a period of six months. This data will be collected and mapped in order to determine the fluctuation of ground water levels and to identify any changes in the direction of localized ground water flow.

First Confined Aquifer

Previous Studies:

Beneath the Pedricktown facility the Cap May Formation lies uncomfortably over the Raritan Formation which has been estimated to be approximately 250 feet thick in this area. The deepest on-site well drilled, 8R, penetrated approximately one hundred feet of the Raritan Formation. Two confined aquifer systems were encountered during drilling, referred to here as the first and second confined aquifers. The soil boring samples show the aquifers were comprised primarily of fine to medium light colored sands, interspersed with clays and silts. Separating the aquifers are extensive reddish silty and sandy clay layers. The origin of the Raritan Formation is continental deposition, facies changes are common and lenses present in one well may not be present in a nearby well. These variabilities can occur both vertically and horizontally.

The first confining layer occurs generally at elevations of ten to thirty feet below sea level and ranges in thickness from ten to twenty feet. There are however some areas where this clay unit is not clearly defined from existing logs. Additional work is needed in these areas to determine the integrity of the confining unit. This will be addressed through a detailed review of existing and proposed gamma ray logging of wells previously not gamma logged.

Of the thirty-nine existing wells at the Pedricktown facility three are known to screen the first confined aquifer. These are 9R2, 10 and 11. Water level elevations collected from these wells indicate that ground water flow beneath the site is towards the north and northeast. Previous studies (Geraghty & Miller, Inc., 1983) indicate the average flow rate to be approximately three feet/day. The thickness of this aquifer based on the three boring logs ranges from ten to thirty feet. The outcrop area is believed to be somewhere between the site and the Delaware River.

The direction of ground water flow beneath the Pedricktown facility in the first confined aquifer is most likely controlled by the pumping of the Raritan Formation by-nearby industry. If the first confined aquifer is in hydraulic contact with the Delaware River, the ground water quality in that aquifer may be impacted by induced flow of river water into the aquifer. Additional investigatory work is needed in the first confined aquifer to determine actual ground water flow direction, the presence of contaminants and geologic conditions.

Additional Hydrogeologic Studies:

An additional first confined aquifer monitoring well will be installed in the area to the northeast of the plant proper (Figure 8). This well will be installed in the northeast area in the immediate vicinity of the water table well proposed for this area. The well will be double cased and installed in accordance with the Double Cased Monitoring Well Installation Protocol for confined aquifers, to be provided in the Site Operations Plan, and will conform to NJDEP requirements for confined aquifer well installation.

All drilling will be conducted by New Jersey State Certified well drillers. At this time it is expected that the wells proposed for the first confined aquifer will be installed using mud rotary drilling techniques.

The proposed well and the three existing first confined aquifer wells (10, 11 9R2) will be included in the two ground water sampling events previously discussed for the water table aquifer. The analytical parameters will also be the same as those listed for the deeper water table aquifer wells. In addition well 11 will be analyzed for cyanide and priority pollutant metals.

During the purging of the newly installed first confined aquifer well for ground water sampling the water levels in the adjacent nested well will be monitored to determine if a direct hydraulic connection exists between the two aquifers. The purpose of this monitoring is to verify that the newly installed first confined aquifer well is properly sealed. If the adjacent water table responds to the purging of the deeper well, it would suggest that the newly installed first confined aquifer well was not successfully sealed and remedial work would be required on that well. Evaluations of any naturally occurring direct hydraulic connection between the water table and the first confined aquifer will be based on the week long ground water elevation monitoring discussed below.

To evaluate the continuity of the confining layer and possible communication between the water table and first confined aquifer ground water levels will be monitored at 15 minute intervals in both aquifers for a period of one week. Previous data collected (Geraghty & Miller, 1983) indicate that the first confined aquifer is affected by the pumping of nearby industrial wells while the water table aquifer is not. These different responses can be used to evaluate the hydraulic connection between the two aquifers. First confined aquifer wells would be expected to show responses to pumping, however, a nearby direct connection with the water table aquifer would act to dampen the pumping response in the first confined aquifer well. Conversely a water table aquifer well would not be expected to respond to the first confined pumping unless there were a nearby direct hydraulic connection. By monitoring ground water levels in wells in both aquifers across the site the continuity of the confining layer across the site can be evaluated. Two groups of wells will be monitored for one week each. Group I consists of wells 9R2, 10, 11, ID, KD, OD, PD and BR. Group II consists of wells 9R2, 10, new first confined, new water table, 2R2, 4R, LD and MD. This monitoring information will also be utilized to evaluate the effects of nearby pumping of the Raritan Formation on the ground water beneath the Pedricktown facility. Water elevations in the Delaware River during this period will be used to evaluate what, if any, impact tidal fluctuations have on ground water elevations.

Second Confined Aquifer

Previous Studies:

One well, 8R, screens the second confining unit beneath the Pedricktown facility, screening seven feet of the aquifer. The second confined aquifer is approximately thirty-five feet thick in this area. Boring logs indicate a confining layer with an average thickness of twenty-five feet separates the first and second aquifers. Well 8R shows no evidence of contamination from the Pedricktown facility as indicated in Table 8. The outcrop area for this aquifer is most likely beneath the Delaware River or across the river into Delaware and Pennsylvania. The water level elevation in well 8R has been continually measured at below sea level indicating a component of flow from the Delaware River toward the site in this aquifer system.

Accordingly additional work in the second confined aquifer is not considered necessary or advisable. No evidence of contamination has been detected in this well, and the majority of the wells in the overlying first confined aquifer also are free of contamination. In addition, despite the available drilling techniques the installation of wells through a confining layer risk cross-contamination.

Off-Site Wells:

Analytical results for samples collected from the residential wells are presented in Table 9. The sampling and analysis of nine residential water wells located north of the site along State Route No. 130 will occur at the same time as one of the site sampling events. Prior to any sampling, owners of residential and public property identified for study will be contacted and requested to sign a "Hold Harmless" release allowing entry of sampling personnel which may include representatives of NL and/or its designated contractor(s). If problems arise in obtaining access to these locations, the USEPA and NJDEP will be notified immediately to assist in the timely completion of this task.

The construction details of these nine wells, if available, will be reviewed prior to sampling. Where possible, the total depth of each well will be sounded and a water level measurement taken. If water treatment is used, the sample will be collected, where possible, from a pre-treatment location. These well samples will be analyzed for the same parameters discussed above for the deep water table aquifer wells with the exception that samples will not be filtered prior to preservation.

Additional off-site wells may be needed to determine the extent of the ground water contamination plume. The need for these wells cannot be determined until after the first round of ground water quality analyses are completed. In addition, the location of any supplemental wells will be dictated by ground water flow directions and water quality. Consequently, an Interim Report will be prepared at the conclusion of round 1 ground water analyses.

The Interim Report will present information developed during the first round of sampling and analyses as well as other relevant data. It will include recommendations for supplemental wells which may be needed. In addition, it will include a revised sampling and analysis plan to reflect addition of organic priority pollutants at selected wells and deletion of some parameters at others. Also included in the Interim Report will be soil sampling results with recommendations for any desired supplemental analyses. **Additionally, initial data and analyses regarding communication between the water table aquifer and the first confined aquifer will be presented.**

6.01.5 Air Investigation

Summarize State Implementation Plan for Site:

The NJDEP and the Environmental Protection Agency (EPA) has stated that the Pedricktown facility poses no threat to atmospheric lead contamination based

on modeling and field investigations. The following discussion was excerpted from the Federal Register, Vol. 50, No. 37 (February 25, 1985): "National Smelting of New Jersey has permanently ceased operations, and all of the company's operating permits have been revoked by the State. The only remaining source is one of fugitive emissions of dust from open slag storage piles at the abandoned plant site. In its supplemental submittal, the State presented dispersion modeling data which show no predicted violations of the ambient lead standard from the slag pile emissions...EPA finds this demonstration of attainment at the former National Smelting of New Jersey site approvable.

[This source has] been...evaluated by the State according to the following procedure:

A field investigation was conducted to identify fugitive emissions.

The total lead emissions rate was calculated using appropriate fugitive emission factors coupled with control efficiencies and operating parameters, and allowable stack emission rates contained in the source's operating permit.

The source was modeled using EPA-approved dispersion modeling methods."

Accordingly, the site has been determined by the NJDEP and the USEPA to be in compliance with the USEPA's State Implementation Plan requirements for attainment and maintenance of the National Ambient Air Quality Standard for lead. Consequently, no further investigation on the threat of atmospheric lead contamination from the site is necessary.

However, any remedial actions which occur at the site could result in agitation of lead bearing material and the generation of fugitive emissions of dust while these activities occur. Methods for containing and/or reducing fugitive emissions will be addressed in the Feasibility Study. A wind rose diagram for the area is presented as Figure 9.

6.02 Site Investigation Analysis

A thorough summary and analysis of all investigations conducted as part of the Remedial Investigation will be prepared. The objective of this task will be to ensure that the data generated during the Remedial Investigation are sufficient in quality and quantity to conduct the Feasibility Study.

The data will be analyzed and a summary of the type and extent of contamination will be developed. The analysis will include all significant pathways of contaminant migration and a public health and environmental risk assessment conforming to "The Endangerment Assessment Handbook" (prepared for EPA by PRC Environmental Management, Inc., 8/85). The analysis will discuss the degree to which either source control or management of migration remedial actions are

required to mitigate the threat to public health, welfare, or the environment. If the results of the investigation indicate that no threat or potential threat exists, a recommendation to stop the remedial response will be made in a formal report.

The data will also be analyzed relative to the preliminary remedial technologies identified as potentially applicable to the site. Data supporting or rejecting the consideration of types of remedial technologies, compatibility of wastes and construction materials, and other conclusions will be presented.

6.03 Preliminary Remedial Technologies

The data generated by the Remedial Investigation will be used to identify remedial technologies potentially applicable to the problems associated with the site based on technical viability. Preliminary remedial alternatives will then be developed from the identified remedial technologies, pursuant to the NCP.

6.04 Remedial Investigation Report

Following the completion of the field investigation all background and field data will be compiled into a Remedial Investigation Report. Site background information was reviewed during the preparation of this Work Plan. Sections 2 and 3 of the Work Plan summarize the site information necessary to develop and technically evaluate the RI/FS Work Plan. The relatively tight schedule for Work Plan submittal prevented a complete review of NJDEP files and completion of all work associated with the background review. The balance of background information reviewed will be summarized in the Site Operations Plan. As part of the RI Report, a section will be devoted to summarizing site background information. It will also present a discussion of lead smelting and other related processes at the Site and at associated industries in the immediate area. The RI Report will also include a scientific literature search summary. Existing scientific literature regarding lead contamination shall be reviewed and written summaries will be presented regarding:

- The effects of lead on the biota found in the Pedricktown area.
- Secondary lead smelters and other lead sources.
- The significance of environmental lead contamination upon public health, welfare, and the environment based on land usages, demographics, and other relevant human and environmental considerations.
- Ranges of background concentrations of lead in matrices that have been monitored in areas similar to Pedricktown.

The literature search will make use of computerized data base services such as DialogTM.

The Report will also include detailed descriptions of the following:

- A topographic survey and resultant plot plan including on-site bench marks.

- A summary of all relevant environmental conditions including annual and seasonal climatic changes.
- Geology of the site including soil types and depths, lithology, thickness of unconsolidated deposits, bedrock depth and type using site investigation results or geologic references.
- Plotted results of geophysical work conducted at the site.
- A determination of the areal and vertical extent of contamination.
- Site plan with locations of all wells, test borings and surface water/leachate sampling points.
- Vertical and horizontal variations in groundwater quality.
- Surface water quality and hydrology of the area.
- Types and concentrations of hazardous constituents detected in the surface soil, surface water and groundwater.
- The location and influence of private and public wells on the movement of groundwater.
- The current or potential impacts from the site on the environment and downgradient public and private water supplies.
- Supporting data including: test boring logs, well specifications, field investigation procedures, chemical analyses, in-situ permeability test data, and monitoring well water level elevations.
- A list of remedial programs to be evaluated as part of the feasibility study.
- References to all scientific or technical literature used to prepare the Report.
- Names, titles and disciplines of all professionals engaged in the Report preparation.

SECTION 7 - FEASIBILITY STUDY WORK PLAN

7.01 Description of Proposed Response

The first step of the Feasibility Study will be to define the objectives of the remedial action and develop response actions. This involves the identification of site problems and pathways of contamination based on data generated by the Remedial Investigation, and identifying general response actions that address the site problems. The response actions fall into two categories: source control measures and management of migration measures. Once the general response actions are identified, the development and evaluation of alternatives may commence.

7.02 Development of Alternatives

Based on the results of the Remedial Investigation a limited number of alternatives for source control or management of migration remedial actions or both will be developed. Remedial response objectives will be identified as will appropriate remedial technologies. Site-specific remedial response objectives shall be based on public health and environmental concerns, information gathered during the Remedial Investigation, and Section 300.68 of the NCP.

Remedial alternatives will be developed to incorporate remedial technologies, response objectives, and other appropriate considerations into a comprehensive, site-specific approach. The approaches considered will take into consideration State and Federal standards in determining an appropriate degree of cleanup. Alternatives will include non-cleanup and no action options, if appropriate.

The alternatives to be evaluated include, but are not limited to, the following, or combinations of the following control options:

1. Establish site security.
2. Control surface water impacts by drainage control.
3. Control infiltration by installation of a low permeability soil cap or paving.
4. Control groundwater movement by providing a groundwater cutoff wall and/or groundwater collection and treatment.
5. Selected removal and secure disposal of identified sources of contaminants likely to have an impact and be mobile.
6. Sealing any wells within the confined aquifers if evidence exists for contaminant migration along or within the well casing.

In accordance with the NCP, at least one alternative shall be developed in each of the following five categories:

1. No action alternative;
2. Alternatives that do not attain applicable or relevant and appropriate Federal public health and environmental requirements but will reduce the probability of present or future threat from the site specific indicator(s) and that provide significant protection to public health and welfare and the environment;
3. Alternatives that attain applicable or relevant and appropriate Federal public health and environmental requirements;
4. Alternatives that exceed applicable or relevant and appropriate Federal public health and environmental requirements; and
5. Alternatives for treatment or disposal at an off-site facility.

If Federal public health and environmental requirements are not applicable or relevant and appropriate, a risk assessment shall be conducted to evaluate the risks of the various exposure levels expected to be remaining after implementation of the alternatives.

7.03 Screening of Alternatives

The remedial alternatives identified will be screened to eliminate alternatives that are not feasible or appropriate.

Three broad considerations will be used as a basis for the initial screening: cost; acceptable engineering practices; and effectiveness. More specifically, the following factors must be considered:

1. Cost - An alternative whose cost far exceeds that of other alternatives without providing substantially greater public health or environmental protection or technical reliability will usually be eliminated from further consideration.
2. Acceptable Engineering Practices - An alternative that is not feasible for the location and conditions of release, is not applicable to the problem, or is not reliable in addressing the problem will be eliminated from further consideration.
3. Effectiveness - An alternative that does not protect public health and the environment will not be considered further. If an alternative results in significant adverse impact and provides limited environmental benefits, it will be excluded from further consideration.

7.04 Evaluation of Alternatives

Remedial alternatives which pass through the initial screening will be evaluated in greater detail. The alternative evaluation shall consist of a detailed description, cost analysis, environmental assessment and technical evaluation as presented below.

Detailed Description:

A detailed description of each alternative will be prepared which will address the following issues, as appropriate.

1. Description of appropriate treatment and disposal technologies.
2. Special engineering considerations required to implement the alternative (e.g., pilot treatment facility, additional studies needed to proceed with final remedial design).
3. Operation, maintenance, and monitoring requirements of the remedy.
4. Off-site disposal requirements and transportation plans.
5. Temporary storage requirements.
6. Safety requirements for remedial implementation (including both on-site and off-site health and safety considerations).
7. A description of how the alternative could be phased into individual operable units. The description should include a discussion of how various operable units of the total remedy could be implemented individually or in groups, resulting in a significant improvement to the environment or savings in cost.
8. A review of any off-site disposal facilities to ensure compliance with applicable Resource Conservation and Recovery Act (RCRA) requirements.

Cost Analysis:

A detailed cost estimate for each remedial alternative will be developed. The cost of each alternative will be presented as a present worth cost and will include the total cost of implementing the alternative and the annual operation and maintenance cost. A distribution of costs over time will be presented.

Environmental Assessment:

An environmental assessment for each alternative shall include, at a minimum, an evaluation of each alternative's environmental effects, an analysis of the measure

to mitigate adverse effects, physical or legal constraints, and compliance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Each alternative will be assessed in terms of the extent to which it will mitigate damage to, or protect, public health, welfare, and the environment in comparison to the other remedial alternatives.

Technical Evaluation:

Each remedial alternative will be evaluated based on technical considerations, including reliability, engineering implementation, and constructability. In terms of reliability, the evaluation shall address operation and maintenance requirements and the demonstrated performance of each component technology. Alternatives which require frequent and/or complex operation and maintenance activities will be considered less reliable than those requiring fewer and/or less complicated operation and maintenance activities. Alternatives which consist of component technologies that have proven effective under conditions similar to those anticipated at the site will be considered more reliable than alternatives with technologies that do not have a proven "track record".

Engineering implementation considers the time required to implement the alternative, safety requirements, and technical practicability. Implementation time includes the time required for additional studies, design, construction, time to realize a benefit, and any other technical considerations required to implement a remedial alternative. An alternative requiring less time to implement would be considered more favorably than an alternative requiring more time. Safety requirements needed to protect on-site workers and offsite receptor populations during implementation are assessed. Those alternatives which pose less of a threat to on-site and off-site personnel, and therefore require less safety precautions to be exercised, will be considered to be more favorable than those requiring more safety precautions. An alternative which is technically more practical to implement based on site conditions will be viewed more favorably than an alternative which is less practical.

Constructability:

The constructability criterion refers to the ease of construction of an alternative. An alternative which requires exotic construction practices would be considered less constructable than an alternative utilizing standard construction techniques.

The lowest cost alternative that is technologically feasible and reliable and that adequately protects (or mitigates damage to) public health, welfare and the environment will be considered the cost-effective remedial alternative.

7.05 Final Report

The Final Report incorporating the Remedial Investigation Report and the results of the Feasibility Study will be prepared and submitted to the EPA. The report will recommend the cost-effective remedial alternative to be implemented for remediation of the site. Relative to the Feasibility Study, the Final Report will contain:

- A summary of all public health and environmental hazards and potential hazards attributable to the site.
- Identification of remedial actions necessary to eliminate existing or potential hazards.
- Identification of technologies capable of achieving the project objectives for each applicable alternative, an evaluation according to the previous section
- Identification of a recommended alternative, including an implementation schedule.

Tables



O'BRIEN & GERE

NLI 001 0317

TABLE 4
ANALYTICAL RESULTS OF ROTARY FURNACE SLAG
NSNJ SITE
PEDRICKTOWN, NJ

<u>Parameter</u>	<u>EP Toxicity Limit</u>	<u>A¹</u>	<u>B²</u>	<u>C²</u>
Arsenic	5.0	0.002	<0.5	<0.2
Barium	100.0	6.3	<0.2	<0.2
Cadmium	1.0	0.03	<0.01	<0.01
Chromium	5.0	0.36	<0.05	<0.05
Lead	5.0	0.14	<0.1	<0.20
Mercury	0.2	0.0002	<0.02	<0.02
Selenium	1.0	0.041	<0.5	<0.3
Silver	5.0	0.01	<0.05	<0.05
Nickel	--	--	<0.05	<0.05
Flash Point	60°	60°	--	
Reactive Sulfide	--	25%	<5.	<5.
Reactive Cyanide	--	ND	<10.	<10.

Notes:

1. Slag samples analyzed by Century Environmental Testing Labs, Inc. All values given as ppm (mg/l) except Flash Point (°C), reactive sulfide (%) and reactive cyanide (%).
2. Slag samples analyzed by Stablax-Reutter, Inc. All values given as ppm (mg/l) except Flash Point (°C), reactive sulfide (mg/g) and reactive cyanide (mg/g).

Table 5

NSNJ Pedricktown
Marsh Water Analytical Results
1981-83

Parameter	Units	North Marsh		South Marsh		Marsh Discharge	
		n	Max	n	Max	n	Max
Mercury Hg	mg/l	1	0.0015	1	(0.0002	-	-
Arsenic As	mg/l	2	0.78	1	0.015	1	0.02
Arsenic Filt.	mg/l	1	0.67	1	0.004	-	-
Barium Ba	mg/l	16	(0.5	-	-	-	-
Cadmium Cd	mg/l	18	0.42	1	0.09	1	0.02
Cadmium Filt.	mg/l	1	0.25	1	0.06	-	-
Chloride Cl	mg/l	18	335	-	-	-	-
Iron Fe	mg/l	19	42000	1	6.3	-	-
Iron Filt.	mg/l	1	4310	1	4.83	-	-
Lead Pb	mg/l	19	7.52	1	3.08	1	2.75
Lead Filt.	mg/l	1	1.38	1	0.36	-	-
Manganese Mn	mg/l	18	11.7	1	0.45	1	1.42
Manganese Filt.	mg/l	1	10.5	1	0.44	-	-
Selenium Se	mg/l	18	0.097	1	(0.0005	1	0.013
Selenium Filt.	mg/l	1	0.113	1	(0.0005	-	-
Sulfate SO ₄	mg/l	18	15500	1	246	1	1400
Tin Sn	mg/l	1	(0.5	-	-	-	-
T.O.C.	mg/l	1	10	-	-	-	-
B.O.D.	mg/l	1	2	-	-	-	-
C.O.D.	mg/l	15	560	1	49	-	-
Hardness	mg/l (as CaCO ₃)	1	129	-	-	-	-
pH	S.U.	18	5.4	1	4.3	1	4.5
Phenols	mg/l	1	(0.002	-	-	-	-
T.D.S.	mg/l	19	23700	1	961	1	7880
Turbidity	NTU	19	48	1	94	1	83

Note:

- North Marsh indicates the sample was obtained in the vicinity of the north end of the culvert which connects the south marsh and the north marsh.
- South Marsh indicates the sample was obtained in the vicinity of the south end of the culvert which connects the south marsh and the north marsh.
- Marsh Discharge indicates the sample was obtained from the north marsh in the vicinity of well 6.
- If two pH values are recorded, the first is the maximum pH and the second value, in the parenthesis, is the minimum pH.
- Samples collected by NL Industries, Inc., analysis conducted by Century Environmental Labs, Inc., Thorofare, NJ.

Table 6
NSNJ Pedricktown
On-site Monitoring Wells
Ground Water Quality Data

Parameter	Units	Well 1R		Well 2R2		Well 3R		Well 4R		Well 5R		Well 6		Well 8R		Well 9R2		Well 10		Well 11		Well 11R	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		2nd Artesian		1st Artesian		1st Artesian		1st Artesian		1st Artesian	
		n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Antimony Sb	ug/l	10	0.146	9	2.3	8	0.178	10	0.05	8	0.042	7	0.053	5	(0.005	7	(0.05	1	0.007	1	0.68	-	-
Arsenic As	ug/l	7	0.07	6	0.186	6	0.036	7	0.035	7	0.021	8	0.037	5	(0.002	2	(0.002	1	(0.002	3	3.1	1	0.040
Arsenic Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.9	1	0.040
Barium Ba	ug/l	5	(0.5	6	0.1	5	(0.5	5	(0.5	5	(0.5	21	(0.5	5	(0.1	1	(0.1	1	(0.1	1	(0.1	-	-
Cadmium Cd	ug/l	7	0.04	6	0.06	6	0.27	7	0.05	7	0.08	23	54	5	(0.01	2	(0.01	1	(0.01	2	1.77	1	(0.01
Cadmium Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	(0.01
Chloride Cl	ug/l	8	765	9	500	8	765	7	197	8	198	22	382	5	23	7	13	1	25	2	310	-	-
Chromium (Total)	ug/l	6	0.05	6	0.05	5	0.03	7	(0.05	7	0.02	7	(0.05	5	(0.01	1	(0.01	1	(0.01	1	0.13	-	-
Chromium (Hex)	ug/l	2	(0.1	6	(0.05	2	(0.1	2	(0.05	2	(0.1	2	(0.1	5	(0.05	1	(0.05	1	(0.05	1	(0.05	-	-
Copper	ug/l	4	0.05	6	0.30	2	0.50	4	0.21	3	0.25	2	0.18	5	0.1	1	0.06	1	(0.01	1	0.12	-	-
Cyanide	ug/l	2	(0.01	6	0.083	2	(0.01	2	(0.01	3	(0.01	2	(0.01	5	0.01	1	(0.01	1	(0.01	1	(0.01	-	-
Fluoride	ug/l	4	0.98	6	1.6	5	0.54	5	1.6	5	0.82	2	1.0	5	(0.1	1	(0.1	1	(0.1	1	1.9	-	-
Iron Fe	ug/l	7	203	9	1.25	7	27.2	8	0.49	7	56	23	224	5	0.80	6	3.53	1	1.39	1	87	-	-
Lead Pb	ug/l	16	0.28	14	0.19	16	0.21	16	0.23	14	0.15	31	0.15	10	0.05	13	0.12	5	0.1	7	0.46	1	0.03
Lead Filter	ug/l	2	(0.01	2	0.06	2	0.15	2	(0.01	2	0.02	2	(0.01	2	(0.01	2	(0.01	2	(0.01	4	0.40	1	0.01
Manganese Mn	ug/l	3	3.7	6	46	3	8.6	3	4	3	1.0	21	3.4	5	0.48	2	0.06	1	0.20	1	22	1	0.82
Manganese Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.81
Mercury	ug/l	5	(0.001	7	0.0006	4	0.27	4	(0.001	4	(0.001	4	(0.001	5	0.0005	-	-	1	(0.0005	1	(0.0005	-	-
Nitrate	ug/l	5	13.0	6	3.5	5	91	5	50.3	5	34	5	16.3	5	3.5	1	(1	1	1.2	1	6.5	-	-
Selenium Se	ug/l	7	0.083	6	0.070	6	0.034	7	0.072	7	0.091	23	0.051	5	(0.005	2	(0.005	1	(0.005	3	(0.0005	1	0.068
Selenium Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	(0.0005	1	0.063
Silver	ug/l	6	0.02	6	0.01	5	(0.01	6	0.01	6	(0.01	5	(0.01	5	0.04	1	(0.01	1	(0.01	1	(0.01	-	-
Sodium	ug/l	2	2530	6	5080	2	375	2	260	2	248	2	850	5	4.4	1	1.8	1	9	1	3220	-	-
Sulfate SO4	ug/l	4	10000	7	11500	3	2230	4	1270	4	9370	23	12500	6	16	3	3	1	26	3	14700	1	6670
Sulfite	ug/l	-	-	-	-	1	2270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin Sn	ug/l	8	(0.5	9	0.5	8	(1.0	8	(1.0	7	(0.5	6	0.5	5	(0.1	7	(0.5	1	(0.5	1	(0.5	-	-
Zinc	ug/l	3	0.55	6	0.63	3	1.5	2	0.21	2	1.1	2	0.27	5	0.03	1	0.04	1	0.20	1	0.88	-	-
T.D.C.	ug/l	-	-	6	100.8	-	-	-	-	-	-	1	12.1	5	24.5	-	-	1	3.8	1	15.8	1	8
Surfactants	ug/l LAS	2	(0.05	6	0.18	3	(0.05	2	(0.05	2	(0.05	1	(0.05	5	(0.05	1	(0.05	1	(0.05	1	(0.05	-	-
B.O.D.	ug/l	8	80	9	42	8	10	8	15	8	7	7	30	5	8	7	10	1	15	1	(5.0	-	-
C.O.D.	ug/l	8	142	9	210	8	38	8	48	8	76	7	103	5	42	7	21	1	63	1	180	-	-
Color	ug/l	1	70	-	-	1	5	1	15	1	15	1	35	-	-	-	-	-	-	-	-	-	-
Hardness	ug/l (as CaCO3)	8	550	9	1300	8	1000	7	617	8	350	5	700	5	44	7	100	1	46	1	764	-	-
Odor	TOW	1	1	4	2	1	4	-	-	1	1	1	2	5	2	1	1	1	1	1	1	-	-
pH	S.U.	10	5.5(4.4)	10	6.8(4.0)	10	5.4(3.3)	10	5.8(4.5)	10	6.1(4.0)	24	6.1(3.3)	6	7.5(6.1)	9	7.5(5.1)	1	7.6	3	7.0(4.8)	1	6.6
Phenols	ug/l	8	0.02	9	0.131	8	0.11	8	0.072	5	0.07	7	0.045	5	0.08	7	0.03	1	(0.01	1	(0.01	-	-
T.D.S.	ug/l	10	13610	9	14000	10	4050	10	1930	9	1680	25	8630	6	120	9	110	1	146	3	22100	1	7795
Turbidity	NTU	10	740	10	95	10	120	10	26	10	120	23	700	6	25	9	150	1	1.8	3	40	1	400
Fecal Coliform	Col/100 ml	2	0	2	0	2	0	1	0	2	0	-	-	5	0	1	0	-	-	-	-	-	-
Total Coliform	Col/100 ml	4	0	4	0	5	0	4	0	4	0	-	-	-	-	1	0	1	0	1	0	-	-
Oil & Grease	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-
NH3 -N	ug/l	-	-	6	310	-	-	-	-	-	-	-	-	5	0.13	-	-	1	0.8	1	825	-	-
Conductivity	micromhos	-	-	6	16000	-	-	-	-	-	-	-	-	5	153	-	-	1	138.5	1	15200	1	9950
TOR	ug/l	-	-	6	145.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	228	-	-
Endrin	ug/l	4	(0.0001	6	(0.1	4	(0.0001	4	(0.0001	4	(0.0001	4	(0.0001	5	(0.1	-	-	-	-	-	-	-	-
Lindane	ug/l	4	(0.0001	6	(0.1	4	(0.0001	4	(0.0001	4	(0.0001	4	(0.0001	5	(0.1	-	-	-	-	-	-	-	-
Methoxychlor	ug/l	4	(0.001	6	(1.0	4	(0.001	4	(0.001	4	(0.001	4	(0.001	5	(1.0	-	-	-	-	-	-	-	-
Toxaphene	ug/l	4	(0.001	6	(1.0	4	(0.001	4	(0.001	4	(0.001	4	(0.001	5	(1.0	-	-	-	-	-	-	-	-
2,4-D	ug/l	4	(0.001	6	(1.0	4	(0.001	4	(0.001	4	(0.001	4	(0.001	5	(1.0	-	-	-	-	-	-	-	-
2,4,5-tri	ug/l	4	(0.001	6	(1.0	4	(0.001	4	(0.001	4	(0.001	4	(0.001	5	(1.0	-	-	-	-	-	-	-	-

Table 6
(continued)
MSNJ Pedricktown
On-site Monitoring Wells
RADIOANALYTICAL DATA

		Well 1R		Well 2R2		Well 3R		Well 4R		Well 5R		Well 6		Well 8R		Well 9R2		Well 10		Well 11		Well 11R		
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		2nd Artesian		1st Artesian		1st Artesian		1st Artesian		1st Artesian		
Parameter	Units	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	
Gross Alpha	pCi/l	4	(50.8	6	270 74	5	23.7	5	15.1	6	23.9	5	33.4	5	155	-	-	1	19	1	100.3	130.8	-	-
Gross Beta	pCi/l	4	31.6	5	41 6.1	5	69.3	5	32.8	6	37.4	5	28.6	5	(14	-	-	-	-	1	12.5	32.8	-	-
Radium (total)	pCi/l	-	-	4	3.05 1.1	-	-	-	-	-	-	-	-	5	2.5 1.2	-	-	-	-	1	2.8	0.4	-	-
Radium 226	pCi/l	4	11.7	1	0.823 0.25	3	2.1	5	2.11	3	3.08	3	2.19	5	(15	-	-	-	-	-	-	-	-	-
Ce-144	pCi/l	1	20.5	-	-	-	(= 38.2	1	(= 48.2	1	(= 41.2	1	47.1	-	-	-	-	-	-	-	-	-	-	-
Ce-141	pCi/l	1	18.4	-	-	-	(= 13.6	1	(= 45.9	1	(= 34.5	1	39.2	-	-	-	-	-	-	-	-	-	-	-
Ru-103	pCi/l	1	11.4	-	-	-	(= 89.6	1	(= 17.2	1	(= 19.2	1	15.3	-	-	-	-	-	-	-	-	-	-	-
Cs-134	pCi/l	1	2.99	-	-	-	(= 5.19	1	(= 4.39	1	(= 5.26	1	4.37	-	-	-	-	-	-	-	-	-	-	-
Ra-226 Bi	pCi/l	1	7.28	-	-	-	15 11	1	(= 9.90	1	(= 11.1	1	11.2	-	-	-	-	-	-	-	-	-	-	-
Ru-106	pCi/l	1	31.1	-	-	-	(= 3.76	1	(= 47.9	1	(= 52.0	1	45.4	-	-	-	-	-	-	-	-	-	-	-
Cs-137	pCi/l	1	3.35	-	-	-	(= 5.76	1	(= 4.78	1	(= 5.46	1	4.98	-	-	-	-	-	-	-	-	-	-	-
Zr-95	pCi/l	1	10.9	-	-	-	(= 11.8	1	(= 18.1	1	(= 18.3	1	16.6	-	-	-	-	-	-	-	-	-	-	-
Nb-95	pCi/l	1	6.70	-	-	-	(= 6.53	1	(= 12.4	1	(= 10.9	1	11.2	-	-	-	-	-	-	-	-	-	-	-
Co-58	pCi/l	1	5.89	-	-	-	(= 6.22	1	(= 11.1	1	(= 8.94	1	10.0	-	-	-	-	-	-	-	-	-	-	-
Mn-54	pCi/l	1	3.41	-	-	-	(= 5.24	1	(= 5.59	1	(= 5.53	1	5.90	-	-	-	-	-	-	-	-	-	-	-
Fe-59	pCi/l	1	16.3	-	-	-	(= 14.0	1	(= 36.1	1	(= 27.8	1	29.9	-	-	-	-	-	-	-	-	-	-	-
Zn-65	pCi/l	1	6.74	-	-	-	(= 11.1	1	(= 13.1	1	(= 13.0	1	13.7	-	-	-	-	-	-	-	-	-	-	-
Co-60	pCi/l	1	2.94	-	-	-	(= 5.38	1	(= 5.59	1	(= 4.49	1	5.62	-	-	-	-	-	-	-	-	-	-	-
K-40	pCi/l	1	36.4	-	-	-	370 90	1	(= 49.8	1	(= 72.1	1	171	-	-	-	-	-	-	-	-	-	-	-
Cr-51	pCi/l	-	-	-	-	-	-	1	(= 268	1	(= 248	-	-	-	-	-	-	-	-	-	-	-	-	-
I-131	pCi/l	-	-	-	-	-	-	1	#	1	#	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba-140 La	pCi/l	-	-	-	-	-	-	1	(= 312	1	(= 216	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6
NSNJ Pedricktown
On-site Monitoring Wells
Ground Water Quality Data

Parameter	Units	Well AR		Well BR		Well BR2		Well CR		Well CR2	
		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max
Antimony Sb	mg/l	1	0.14	-	-	-	-	-	-	-	-
Arsenic As	mg/l	-	-	1	0.003	-	-	1	0.002	-	-
Arsenic Filter	mg/l	-	-	-	-	-	-	-	-	-	-
Barium Ba	mg/l	22	10.5	-	-	2	10.5	20	10.5	23	10.5
Cadmium Cd	mg/l	23	1.2	1	0.01	2	10.01	21	0.02	23	0.04
Cadmium Filter	mg/l	-	-	-	-	-	-	-	-	-	-
Chloride Cl	mg/l	22	4250	-	-	2	13	20	350	23	1500
Chromium (Total)	mg/l	-	-	-	-	-	-	-	-	-	-
Chromium (Hex)	mg/l	-	-	-	-	-	-	-	-	-	-
Copper	mg/l	-	-	-	-	-	-	-	-	-	-
Cyanide	mg/l	-	-	-	-	-	-	-	-	-	-
Fluoride	mg/l	-	-	-	-	-	-	-	-	-	-
Iron Fe	mg/l	22	1200	-	-	2	27.2	20	127	23	1.18
Lead Pb	mg/l	28	1.01	1	0.02	2	0.06	26	0.07	28	0.32
Lead Filter	mg/l	2	0.30	-	-	-	-	2	0.07	2	0.25
Manganese Mn	mg/l	23	16.5	1	4.9	2	0.24	21	3.56	23	10.8
Manganese Filter	mg/l	-	-	-	-	-	-	-	-	-	-
Mercury	mg/l	-	-	-	-	-	-	-	-	-	-
Nitrate	mg/l	-	-	-	-	-	-	-	-	-	-
Selenium Se	mg/l	23	0.3	1	0.005	2	0.005	21	0.01	23	0.11
Selenium Filter	mg/l	-	-	-	-	-	-	-	-	-	-
Silver	mg/l	-	-	-	-	-	-	-	-	-	-
Sodium	mg/l	-	-	-	-	-	-	-	-	-	-
Sulfate SO4	mg/l	23	20750	1	12500	2	26.4	22	1710	24	19600
Sulfite	mg/l	-	-	-	-	-	-	-	-	-	-
Tin Sn	mg/l	-	-	-	-	-	-	-	-	-	-
Zinc	mg/l	-	-	-	-	-	-	-	-	-	-
T.D.C.	mg/l	2	27	-	-	-	-	-	-	2	13.8
Surfactants	mg/l LAS	-	-	-	-	-	-	-	-	-	-
B.O.D.	mg/l	-	-	-	-	-	-	-	-	-	-
C.D.D.	mg/l	-	-	-	-	-	-	-	-	-	-
Color	-	-	-	-	-	-	-	-	-	-	-
Hardness	mg/l (as CaCO3)	-	-	-	-	-	-	-	-	-	-
Odor	TON	-	-	-	-	-	-	-	-	-	-
pH	S.U.	23	4.0(1.7)	2	5.9(4.9)	2	6.1(5.9)	21	7.3(5.7)	23	6.5(4.8)
Phenols	mg/l	-	-	-	-	-	-	-	-	-	-
T.D.S.	mg/l	24	26760	1	16700	2	114	22	1410	24	30100
Turbidity	NTU	22	20	1	2.8	2	89	20	125	22	22
Fecal Coliform	Col/100 ml	-	-	-	-	-	-	-	-	-	-
Total Coliform	Col/100 ml	-	-	-	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-	-	-	-	-
NH3 -N	mg/l	-	-	-	-	-	-	-	-	-	-
Conductivity	micromohs	-	-	-	-	-	-	-	-	-	-
TDH	ug/l	-	-	-	-	-	-	-	-	-	-
Endrin	ug/l	-	-	-	-	-	-	-	-	-	-
Lindane	ug/l	-	-	-	-	-	-	-	-	-	-
Methoxychlor	ug/l	-	-	-	-	-	-	-	-	-	-
Toxaphene	ug/l	-	-	-	-	-	-	-	-	-	-
2,4-D	ug/l	-	-	-	-	-	-	-	-	-	-
2,4,5-TP	ug/l	-	-	-	-	-	-	-	-	-	-

Table 6
(continued)
NSNJ Pedricktown
On-site Monitoring Wells
RADICANALYTICAL DATA

Parameter	Units	Well AR		Well BR		Well BR2		Well CR		Well CR2	
		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max
Gross Alpha	pCi/l	-	-	-	-	-	-	-	-	-	-
Gross Beta	pCi/l	-	-	-	-	-	-	-	-	-	-
Radium (total)	pCi/l	-	-	-	-	-	-	-	-	-	-
Radium 226	pCi/l	-	-	-	-	-	-	-	-	-	-
Ce-144	pCi/l	-	-	-	-	-	-	-	-	-	-
Ce-141	pCi/l	-	-	-	-	-	-	-	-	-	-
Ru-103	pCi/l	-	-	-	-	-	-	-	-	-	-
Cs-134	pCi/l	-	-	-	-	-	-	-	-	-	-
Ra-226 Bi	pCi/l	-	-	-	-	-	-	-	-	-	-
Ru-106	pCi/l	-	-	-	-	-	-	-	-	-	-
Cs-137	pCi/l	-	-	-	-	-	-	-	-	-	-
Zr-95	pCi/l	-	-	-	-	-	-	-	-	-	-
Nb-95	pCi/l	-	-	-	-	-	-	-	-	-	-
Co-58	pCi/l	-	-	-	-	-	-	-	-	-	-
Mn-54	pCi/l	-	-	-	-	-	-	-	-	-	-
Fe-59	pCi/l	-	-	-	-	-	-	-	-	-	-
Zn-65	pCi/l	-	-	-	-	-	-	-	-	-	-
Co-60	pCi/l	-	-	-	-	-	-	-	-	-	-
K-40	pCi/l	-	-	-	-	-	-	-	-	-	-
Cr-51	pCi/l	-	-	-	-	-	-	-	-	-	-
I-131	pCi/l	-	-	-	-	-	-	-	-	-	-
Ba-140 La	pCi/l	-	-	-	-	-	-	-	-	-	-

Notes:

- If two pH values are recorded, the first value is the maximum pH and the second value, in the parenthesis, is the minimum pH.
- Samples collected by NL Industries, Inc., Geraghty & Miller, Inc., and New Jersey Department of Environmental Protection. Analyses conducted by Century Environmental Labs, Inc., and New Jersey Department of Environmental Protection.

Table 7
NSNJ Pedricktown
Observation Wells
Ground Water Quality Data

Parameter	Units	Well HS		Well HD		Well IS		Well ID		Well JS		Well JD		Well KS		Well KD		Well LS		Well LD		Well MS		Well MD	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Antimony Sb	ug/l	-	-	1	(0.05	1	(0.05	1	(0.05	-	-	-	-	1	(0.05	-	-	-	-	-	-	-	-	-	-
Arsenic As	ug/l	-	-	1	0.024	1	0.041	1	0.232	-	-	-	-	1	0.046	-	-	-	-	-	-	-	-	-	-
Arsenic Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium Ba	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium Cd	ug/l	-	-	1	0.06	1	0.02	1	0.02	-	-	-	-	1	0.27	-	-	-	-	-	-	-	-	-	-
Cadmium Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride Cl	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium (Total)	ug/l	-	-	1	0.16	1	(0.05	1	0.29	-	-	-	-	1	0.22	-	-	-	-	-	-	-	-	-	-
Chromium (Hex)	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	ug/l	-	-	1	0.13	1	(0.05	1	0.14	-	-	-	-	1	0.43	-	-	-	-	-	-	-	-	-	-
Cyanide	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron Fe	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead Pb	ug/l	2	2.65	3	0.18	3	1.10	3	0.23	2	10.73	2	0.21	3	0.39	2	0.31	2	0.17	2	0.32	2	0.24	2	3.86
Lead Filter	ug/l	3	2.36	3	0.06	3	0.85	3	(0.01	3	9.59	3	0.02	3	0.23	3	0.28	3	0.06	3	0.32	3	0.24	3	3.62
Manganese Mn	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/l	-	-	1	(0.001	1	(0.001	1	0.001	-	-	-	-	1	(0.001	-	-	-	-	-	-	-	-	-	-
Nitrate	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium Se	ug/l	-	-	1	0.104	1	0.081	1	0.14	-	-	-	-	1	0.157	-	-	-	-	-	-	-	-	-	-
Selenium Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/l	-	-	1	0.01	1	(0.01	1	0.052	-	-	-	-	1	0.03	-	-	-	-	-	-	-	-	-	-
Sodium	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate SO4	ug/l	3	7500	3	2580	3	1250	3	483	3	4490	3	1360	2	3520	3	1480	3	76	3	11100	3	8550	3	212
Sulfite	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin Sn	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	ug/l	-	-	1	0.01	1	0.20	1	0.33	-	-	-	-	1	1.4	-	-	-	-	-	-	-	-	-	-
T.O.C.	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surfactants	ug/l LPS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B.O.D.	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.O.D.	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Color	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hardness	ug/l (as CaCO3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odor	TDM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	S.U.	3	4.6(2.6)	3	5.8(4.2)	3	6.0(4.5)	3	6.3(4.0)	3	5.0(3.4)	3	6.1(3.5)	3	5.1(3.3)	3	6.0(4.4)	3	5.0(3.3)	3	4.4(2.6)	3	4.2(2.4)	3	7.3(4.0)
Phenols	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T.D.S.	ug/l	2	8250	2	3500	2	1753	2	855	2	5600	2	2360	2	5320	2	2180	2	272	2	15800	2	11300	2	373
Turbidity	NTU	2	11000	2	5.5	2	62	2	250	2	3.8	2	4.5	2	45	2	30	2	73	2	(1000	2	16	2	70
Fecal Coliform	Col/100 ml	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-</							

Table 7
(continued)
MSNJ Pedricktown
Observation Wells
RADIOANALYTICAL DATA

		Well HS		Well HD		Well IS		Well ID		Well JS		Well JD		Well KS		Well KD		Well LS		Well LD		Well MS		Well MD	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table	
Parameter	Units	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Gross Alpha	pCi/l	-	-	-	-	-	-	-	-	1	193 40	-	133 28	-	-	-	-	-	-	-	-	1	15.8 3.12	1	51 16
Gross Beta	pCi/l	-	-	-	-	-	-	-	-	1	166 25	1	96 16	-	-	-	-	-	-	-	-	1	19.6 2.19	1	55 10
Radium (total)	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Radium 226	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ce-144	pCi/l	-	-	-	-	-	-	-	-	1	39.0	1	22.5	-	-	-	-	-	-	-	-	1	(= 40.6	1	31.3
Ce-141	pCi/l	-	-	-	-	-	-	-	-	1	30.1	1	5.48	-	-	-	-	-	-	-	-	1	(= 35.8	1	26.3
Ru-103	pCi/l	-	-	-	-	-	-	-	-	1	16.5	1	10.6	-	-	-	-	-	-	-	-	1	(= 13.7	1	10.4
Cs-134	pCi/l	-	-	-	-	-	-	-	-	1	4.75	1	3.57	-	-	-	-	-	-	-	-	1	(= 3.19	1	2.98
Ra-226 B1	pCi/l	-	-	-	-	-	-	-	-	1	16 9	1	8.41	-	-	-	-	-	-	-	-	1	(= 9.08	1	8.08
Ru-106	pCi/l	-	-	-	-	-	-	-	-	1	47.8	1	35.2	-	-	-	-	-	-	-	-	1	(= 40.6	1	30.2
Ce-137	pCi/l	-	-	-	-	-	-	-	-	1	5.10	1	3.91	-	-	-	-	-	-	-	-	1	(= 4.08	1	3.18
Zr-95	pCi/l	-	-	-	-	-	-	-	-	1	16.4	1	12.1	-	-	-	-	-	-	-	-	1	(= 15.0	1	11.1
Nb-95	pCi/l	-	-	-	-	-	-	-	-	1	9.30	1	7.00	-	-	-	-	-	-	-	-	1	(= 10.5	1	7.73
Co-58	pCi/l	-	-	-	-	-	-	-	-	1	8.71	1	6.12	-	-	-	-	-	-	-	-	1	(= 8.72	1	6.63
Mn-54	pCi/l	-	-	-	-	-	-	-	-	1	5.30	1	3.83	-	-	-	-	-	-	-	-	1	(= 5.13	1	3.97
Fe-59	pCi/l	-	-	-	-	-	-	-	-	1	25.4	1	17.1	-	-	-	-	-	-	-	-	1	(= 27.7	1	20.1
Zn-65	pCi/l	-	-	-	-	-	-	-	-	1	12.0	1	8.17	-	-	-	-	-	-	-	-	1	(= 12.2	1	9.14
Co-60	pCi/l	-	-	-	-	-	-	-	-	1	5.02	1	4.05	-	-	-	-	-	-	-	-	1	(= 5.09	1	3.79
K-40	pCi/l	-	-	-	-	-	-	-	-	1	50.9	1	43.8	-	-	-	-	-	-	-	-	1	(= 48.1	1	40.3
Cr-51	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(= 209	-	-
I-131	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba-140 La	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(= 233	-	-

Table 7
NSNJ Pedricktown
Observation Wells
Ground Water Quality Data

Parameter	Units	Well NS		Well ND		Well OS		Well OD		Well PS		Well PD		Well QS		Well QD		Well RS		Well RD		Well SS		Well SD	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Antimony Sb	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	10.05
Arsenic As	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.031
Arsenic Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium Ba	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium Cd	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.01
Cadmium Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride Cl	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium (Total)	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.4	1	0.29
Chromium (Hex)	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	1	0.28
Cyanide	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron Fe	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead Pb	ug/l	2	1.18	2	0.12	2	0.65	2	0.66	2	0.02	2	0.27	1	0.08	2	0.20	2	2.96	2	2.01	2	2.7	2	0.32
Lead Filter	ug/l	3	0.51	3	0.01	3	0.43	3	0.54	3	0.02	3	0.14	2	0.08	2	0.14	3	2.52	3	1.70	2	10.01	2	0.05
Manganese Mn	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.015	1	10.001
Nitrate	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selenium Se	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.044
Selenium Filter	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.04
Sodium	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate SO4	ug/l	3	480	3	3900	3	5300	3	9000	3	536	3	1300	2	2600	2	14500	3	35500	3	8380	2	70	2	63
Sulfite	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin Sn	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2.0	1	0.91
T.O.C.	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surfactants	ug/l LRS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B.O.D.	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.O.D.	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Color	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hardness	ug/l (as CaCO3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odor	TUN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	S.U.	3	6.0(4.0)	3	5.5(3.7)	3	5.6(3.5)	3	5.5(3.5)	3	7.0(4.0)	3	7.1(4.5)	2	6.6(4.0)	2	5.6(4.6)	3	4.2(2.2)	3	6.8(2.6)	2	7.2(5.0)	2	7.2(5.0)
Phenols	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T.D.S.	ug/l	2	550	2	3090	3	7490	2	10500	2	910	2	1880	2	2400	2	20700	2	35100	2	8580	2	202	2	215
Turbidity	NTU	2	757	2	33	2	95	2	20	2	6.8	2	5.0	2	62	2	150	2	125	2	150	2	22	2	11000
Fecal Coliform	Col/100 ml	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Coliform	Col/100 ml	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NH3 -N	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conductivity	micromohs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TUN	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endrin	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lindane	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methoxychlor	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toxaphene	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4-D	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,5-TD	ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 7
(continued)
NSNJ Pedricktown
Observation Wells
RADIOANALYTICAL DATA

Parameter	Units	Well NS		Well ND		Well OS		Well OD		Well PS		Well PD		Well QS		Well QD		Well RS		Well RD		Well SS		Well SD	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Gross Alpha	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	604 90	1	76 16	-	-	-	-	-	-
Gross Beta	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	350 34	1	69 12	-	-	-	-	-	-
Radium (total)	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radium 226	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ce-144	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	20.5	-	-	-	-	-	-
Ce-141	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	16.3	-	-	-	-	-	-
Ru-103	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	9.70	-	-	-	-	-	-
Cs-134	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2.89	-	-	-	-	-	-
Ra-226 Bi	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6.53	-	-	-	-	-	-
Ru-106	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	31.1	-	-	-	-	-	-
Cs-137	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3.28	-	-	-	-	-	-
Zr-95	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	10.7	-	-	-	-	-	-
Nb-95	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2.72	-	-	-	-	-	-
Co-58	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5.33	-	-	-	-	-	-
Mn-54	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3.30	-	-	-	-	-	-
Fe-59	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	15.0	-	-	-	-	-	-
Zn-65	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7.01	-	-	-	-	-	-
Co-60	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3.00	-	-	-	-	-	-
K-40	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	30.7	-	-	-	-	-	-
Cr-51	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-131	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba-140 La	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Well T2	Well T2-1	Well T2-2	Well T2-3	Well T4
Water Table	Water Table	Water Table	Water Table	Water Table

NLI 001 0328

Table 8
(continued)
NSNJ Pedricktown
Ground Water Abatement System
RADIOANALYTICAL DATA

Parameter	Units	GWAS NW1		GWAS NW2		GWAS NW3		GWAS NE1		GWAS NE2		GWAS NE3		GWAS SW1		GWAS SW2		GWAS SE SPLIT		GWAS SE1		GWAS SE2		GWAS SE3	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Gross Alpha	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross Beta	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radium (total)	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radium 226	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ce-144	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ce-141	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ru-103	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cs-134	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ra-226 Bi	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ru-106	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cs-137	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zr-95	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nb-95	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co-58	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mn-54	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe-59	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn-65	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co-60	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K-40	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cr-51	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-131	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba-140 La	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

- Samples collected by NL Industries, Inc.; analysis conducted by Century Environmental Labs, Inc., Thorofare, NJ.

Table 9
(continued)
NSNJ Pedricktown
Residential Wells
RADIOANALYTICAL DATA

Parameter	Units	Well PM1		Well PM2		Well PM3		Well PM4		Well PM5		Well PM6		Well PM7		Well PM8		Well PM9		Marshall Well	
		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table		Water Table	
		n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max	n	Max
Gross Alpha	pCi/l	2	1.75 0.62	2	2.87 0.86	2	1.95 0.41	2	2.28 0.62	2	0.68 0.39	2	3.91 2.2	2	0.81 0.30	1	1.34 0.39	2	3.91 2.08	-	-
Gross Beta	pCi/l	2	1.99 0.36	2	3.48 0.42	2	2.31 0.29	2	2.11 0.29	2	2.81 0.25	2	8.17 1.91	2	3.41 0.31	1	0.52 0.86	2	33.7 2.5	-	-
Radium (total)	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radium 226	pCi/l	1	0.40 0.17	1	0.02 0.12	1	0.47 0.18	1	0.26 0.15	1	0.10	1	1.27 0.25	1	0.14 0.14	-	-	1	1.33 0.25	-	-
Ce-144	pCi/l	1	(= 38.5	1	(= 36.7	1	(= 37.7	1	(= 38.6	1	(= 38.6	1	(= 35.4	1	(= 36.7	1	(= 22.3	1	(= 40.8	-	-
Ce-141	pCi/l	1	(= 16.9	1	(= 14.1	1	(= 14.1	1	(= 17.4	1	(= 17.7	1	(= 16.5	1	(= 47.4	1	(= 14.8	1	(= 28.0	-	-
I-131	pCi/l	1	(= 96.0	1	(= 56.6	1	(= 51.4	1	(= 100	1	(= 110	1	(= 112	1	NDA N/A	1	(= 404	1	(= 900	-	-
Ru-103	pCi/l	1	(= 9.80	1	(= 9.80	1	(= 8.74	1	(= 10.2	1	(= 9.95	1	(= 9.44	1	(= 23.7	1	(= 8.72	1	(= 16.2	-	-
Cs-134	pCi/l	1	(= 6.99	1	(= 6.99	1	(= 4.97	1	(= 7.40	1	(= 6.95	1	(= 6.49	1	(= 4.44	1	(= 2.86	1	(= 5.29	-	-
Ra-266 Bi	pCi/l	1	(= 18.1	1	(= 18.1	1	(= 9.92	1	(= 17.9	1	(= 17.8	1	(= 16.8	1	17 12	1	(= 5.49	1	(= 10.7	-	-
Ru-106	pCi/l	1	(= 58.0	1	(= 58.0	1	(= 49.2	1	(= 59.6	1	(= 56.3	1	(= 50.2	1	(= 46.3	1	(= 28.7	1	(= 51.5	-	-
Cs-137	pCi/l	1	(= 6.20	1	(= 6.20	1	(= 5.68	1	(= 6.38	1	(= 6.24	1	(= 5.74	1	(= 4.67	1	(= 3.07	1	(= 5.55	-	-
Zr-95	pCi/l	1	(= 13.6	1	(= 13.6	1	(= 11.3	1	(= 14.5	1	(= 13.8	1	(= 13.3	1	(= 20.3	1	(= 8.96	1	(= 17.2	-	-
Nb-95	pCi/l	1	(= 8.43	1	(= 8.43	1	(= 7.13	1	(= 8.52	1	(= 8.89	1	(= 7.81	1	(= 11.6	1	(= 5.11	1	(= 9.92	-	-
Co-58	pCi/l	1	(= 7.86	1	(= 7.86	1	(= 5.99	1	(= 8.81	1	(= 8.22	1	(= 7.85	1	(= 9.80	1	(= 4.61	1	(= 8.50	-	-
Mn-54	pCi/l	1	(= 6.77	1	(= 6.77	1	(= 5.11	1	(= 6.63	1	(= 6.63	1	(= 5.86	1	(= 5.09	1	(= 3.03	1	(= 5.81	-	-
Fe-59	pCi/l	1	(= 18.8	1	(= 18.8	1	(= 14.2	1	(= 19.8	1	(= 18.7	1	(= 17.4	1	(= 33.6	1	(= 12.6	1	(= 24.2	-	-
Zn-65	pCi/l	1	(= 16.3	1	(= 16.3	1	(= 11.6	1	(= 17.5	1	(= 17.0	1	(= 15.3	1	(= 11.1	1	(= 6.62	1	(= 13.2	-	-
Co-60	pCi/l	1	(= 5.97	1	(= 5.97	1	(= 5.22	1	(= 6.03	1	(= 5.41	1	(= 6.04	1	(= 4.64	1	(= 2.99	1	(= 5.55	-	-
K-40	pCi/l	1	(= 148	1	390 30	1	340 90	1	(= 147	1	(= 154	1	(= 142	1	(= 52.0	1	(= 26.5	1	(= 16.9	-	-
Cr-51	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-131	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba-140 La	pCi/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

- Samples collected and analyzed by New Jersey Department of Environmental Protection.

0
NSNJ Pearicktown Site
OBSERVATION and MONITORING WELL DATA SUMMARY

Well No.	Land Surface Elevation	Top of Casing Elevation	Screened Interval Elevation Below Land Surface	Length of Screened Interval	Lithology of Screened Interval	Construction Date of Well	Construction Methods for Wells Listed
HD	14.13	16.73	-9.67 to -24.67	15'	sand; silt	December, 1982	<u>Drilling Method:</u> auger
HS	14.23	16.83	4.83 to -10.17	15'	silt; sand	December, 1982	
ID	12.64	15.24	-5.96 to -20.96	15'	sand	December, 1982	<u>Sampling Method:</u> Split-spoon
IS	12.91	15.41	7.41 to -0.09	10'	sand; silt	December, 1982	sampling at 5' intervals in wells
JD	9.18	12.08	-5.92 to -15.92	10'	sand	December, 1982	completed in the lower water table
JS	9.35	11.95	4.95 to -5.05	10'	sand	December, 1982	zone.
KD	8.1	10.70	-7.3 to -17.3	10'	sand	December, 1982	
KS	8.01	10.51	2.51 to -7.49	10'	sand	December, 1982	<u>Casing:</u> 2" ID; Sch. 40 PVC with
LD	8.59	10.89	-1.11 to -8.11	7'	sand; clay	December, 1982	20 slot screen
LS	8.64	10.74	4.74 to -2.31	7'	sand	December, 1982	
MD	6.37	8.37	-3.23 to -11.23	8'	silt; sand	December, 1982	
MS	7.03	9.83	3.83 to -3.17	7'	sand; silt	December, 1982	
ND	8.25	10.35	-3.65 to -13.65	10'	sand	December, 1982	
NS	8.7	11.30	4.5 to -5.5	10'	sand	December, 1982	
OD	8.44	11.44	-11.06 to -26.06	15'	sand	December, 1982	
PD	7.05	10.92	-9.75 to -19.75	10'	sand	December, 1982	
PS	7.04	10.25	-0.86 to -10.86	10'	sand	December, 1982	
QD	7.69	9.14	-3.81 to -13.81	10'	sand	December, 1982	
QS	7.92	10.19	5.52 to -4.48	10'	sand	December, 1982	
RD	11.62	13.62	-13.38 to -23.38	10'	clay; silt	December, 1982	
RS	11.84	13.84	6.84 to -8.16	15'	sand; clay	December, 1982	
SD	8.95	11.45	-6.05 to -18.05	12'	sand	December, 1982	
SS	8.76	10.76	3.76 to -6.24	10'	sand	December, 1982	
T2	8.94	11.34	1.34 to -13.66	15'	sand	December, 1982	
*T4	9.09	11.09	1.09 to -13.91	15'	sand	December, 1982	<u>NOTE:</u> *T4 = Casing: 4" ID; Sch.

80 PVC with 20 slot screen

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ib' Cont
NSNJ Ficktown Site
OBSERVATION and MONITORING WELL DATA SUMMARY

Well No.	Land Surface Elevation	Top of Casing Elevation	Screened Interval Elevation Below Land Surface	Length of Screened Interval	Lithology of Screened Interval	Construction Date of Well	Construction Methods for Wells Listed
1R	9.32	13.32	5.32 to -22.68	28'	sand; silt; sand; clay	December 14, 1979	Mud rotary - Ditch & split-spoon sampling; 4" ID; PVC; 20 slot screen
2R2	6.94	9.14	-6.06 to 13.06	7'	sand; gravel; clay	October 15, 1980	Water rotary - Ditch sampling; 4" ID; PVC; 20 slot screen
3R	11.4	14.10	7.4 to -21.6	29"	sand; clay; sand; clay	December 17, 1979	Mud rotary - Ditch sampling; 4" ID; PVC; 20 slot screen
4R	12.1	14.80	3.1 to -8.9	12'	sand; clay	July 21, 1980	Water rotary - Ditch sampling; 4" ID; PVC; 20 slot screen
5R	8.03	10.03	1.03 to -7.7	9'	sand; clay	July 22, 1980	Water rotary - Ditch sampling; 4" ID; PVC; 20 slot screen
6	9.73	12.23	-1.27 to -11.27	10'	sand; clay	October 8, 1976	Auger; split spoon sampling; 4" ID; PVC; 40 slot screen
8R	13.65	16.55	-87.35 to -94.35	7'	sand; clay	March 19, 1980	Mud Rotary; Split spoon sampling; 4" ID; PVC; 20 slot screen
9R2	13.93	16.73	-39.07 to -47.07	8'	sand; clay	April 2, 1980	Water Rotary; Unknown sampling method; 4" ID; PVC; 20 slot screen
AR	8.89	11.39	6.39 to -23.61	30'	sand; clay	December 12-13, 1979	Mud Rotary; Ditch and Split spoon sampling; 4" ID; PVC; 20 slot screen
BR	6.58	8.88	-24.42 to -30.42	6'	sandy clay; sand	April 1, 1980	Water Rotary; Ditch sampling; 4" ID; PVC; 20 slot screen
CR2	13.16	15.96	-11.84 to -17.84	6'	sand	March 29, 1980	Water Rotary; Ditch sampling; 4" ID; PVC; 20 slot screen
10	11.72	13.72	-30.28 to -60.28	30'	sand; clay; sand	*	Auger; split spoon and Shelby tube sampling; 4" ID; PVC; 20 slot screen
11	7.45	9.25	-25.75 to -45.75	20'	sand	*	Auger; split spoon sampling; 4" ID; PVC; 20 slot screen
11R	*	*	*	20'	sand; clay	October 14, 1983	Drilling method unknown; sampling method unknown; 4" ID; 20 slot screen

* No information available

TABLE 11
NSNJ PEDRICKTOWN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCHEDULE

<u>Task</u>	<u>Duration</u> ¹	<u>Predecessor</u>
1. Work Plan Preparation	--	
2. Operations Plan Preparation	30 days	1
3. Access Obtained, Safety Survey	60 days	Approval of 2
4. Field Investigations-First	30 days	2, 3
5. Laboratory Analyses	40 days	4
6. Data Analysis/Interim Report	30 days	4, 5
7. Field Investigation-Second	30 days	Approval of 6
8. Laboratory Analyses	40 days	7
9. Data Analysis and Draft RI Report	90 days	8
10. Final RI Report	30 days	Receipt of Comments on 9
11. Remedial Alternatives Development	30 days	9
12. Remedial Alternatives Screening	30 days	10
13. Remedial Alternatives Evaluation	90 days	Approval of 10
14. Draft RI/FS Report	60 days	13
15. Final RI/FS Report	30 days	Receipt of Comments on 14

(1) Working Days - excludes public holidays and weekends

Table 1

NSNJ Pedricktown
1980-81 Soil Sampling Results
Total Lead Analysis

Location	Depth	20M	Dry	Wet
1	0"-2"	2660	2490	2250
	5"-7"	36	33	32
	11"-13"	-	-	-
2	0"-2"	948	853	730
	5"-7"	51	48	43
	11"-13"	-	-	-
3	0"-2"	72	87	81
	5"-7"	-	-	-
	11"-13"	-	-	-
4	0"-2"	47700	36380	32650
	5"-7"	3600	3260	3130
	11"-13"	94	88	84
5	0"-2"	8300	7460	6490
	5"-7"	1260	1140	1090
	11"-13"	123	112	106
6	0"-2"	30400	16400	14500
	5"-7"	83600	58300	54600
	11"-13"	2860	2610	2480
7	0"-2"	2660	2260	2070
	5"-7"	82800	67000	60000
	11"-13"	35700	19400	18400
8	0"-2"	4000	3890	3680
	5"-7"	120	108	102
	11"-13"	-	-	-
9	0"-2"	612	537	502
	5"-7"	83	73	68
	11"-13"	-	-	-
10	0"-2"	6020	4420	4180

Notes:

- 20 M indicates analytical results for that portion of dried, ground original sample that passed through a 20 mesh standard sieve.
- Dry indicates analytical results for original sample reported on a dry weight basis.
- Wet indicates analytical results for original sample reported on a wet weight basis.
- All values reported in ppm (mg/kg).
- Samples collected by NL Industries, Inc., analysis conducted by Century Environmental Labs, Inc., Thorofare, NJ.

Table 1

NSNJ Pedricktown
1980-81 Soil Sampling Results
Total Lead Analysis

Location	Depth	20M	Dry	Wet
28B	0"-2"	3000	5590	5090
	5"-7"	3660	3150	2980
	11"-13"	-	-	-
29	0"-2"	3290	2280	2070
	5"-7"	4900	3890	3500
	11"-13"	2680	2220	2100
30	0"-2"	142	118	105
	5"-7"	-	-	-
	11"-13"	-	-	-
31	0"-2"	1820	1690	1520
	5"-7"	27	25	24
	11"-13"	-	-	-
32	0"-2"	114	102	91
	5"-7"	-	-	-
	11"-13"	-	-	-
33	0"-2"	410	324	130
	5"-7"	-	-	-
	11"-13"	-	-	-
34	0"-2"	710	354	333
	5"-7"	15	9	8
	11"-13"	-	-	-
35	0"-2"	452	241	220
	5"-7"	-	-	-
	11"-13"	-	-	-
36	0"-2"	130	53	49
	5"-7"	-	-	-
	11"-13"	-	-	-

Notes:

- 20 M indicates analytical results for that portion of dried, ground original sample that passed through a 20 mesh standard sieve.
- Dry indicates analytical results for original sample reported on a dry weight basis.
- Wet indicates analytical results for original sample reported on a wet weight basis.
- All values reported in ppm (mg/kg).
- Samples collected by NL Industries, Inc., analysis conducted by Century Environmental Labs, Inc., Thorofare, NJ.

Table 1

NSNJ Pedricktown
1980-81 Soil Sampling Results
Total Lead Analysis

Location	Depth	20M	Dry	Wet
37	0"-2"	800	417	354
	5"-7"	908	598	572
	11"-13"	4680	2800	2640
38	0"-2"	570	314	295
	5"-7"	133	75	72
	11"-13"	-	-	-
39	0"-2"	338	142	135
	5"-7"	-	-	-
	11"-13"	-	-	-
40	0"-2"	4200	3770	2390
	5"-7"	95	85	57
	11"-13"	-	-	-

Notes:

- 20 M indicates analytical results for that portion of dried, ground original sample that passed through a 20 mesh standard sieve.
- Dry indicates analytical results for original sample reported on a dry weight basis.
- Wet indicates analytical results for original sample reported on a wet weight basis.
- All values reported in ppm (mg/kg).
- Samples collected by NL Industries, Inc., analysis conducted by Century Environmental Labs, Inc., Thorofare, NJ.

TABLE 2
MARSH MUD SAMPLING RESULTS

SAMPLE LOCATION		SHALLOW SAMPLE		DEEP SAMPLE	
NUMBER	DEPTH	PB (mg/kg)		DEPTH	PB (mg/kg)
1	12"	20		23"	1.69
2	11"	140		21"	25.4
3	11"	2,600		22"	105
4	12"	16,800		23"	243
5	13"	18,300		26"	2880
6	13"	1,000		26"	897
7	12"	<100		24"	85.6
8	13"	100		62"	7.91
9	9"	400		18"	8.54
10	12"	40		23"	2.68
11	9"	400		17"	13.8
12	10"	100		20"	12.8
13	11"	400		22"	99.8
14	15"	<100		31"	10.5
15	12"	200		24"	17.1
16	11"	600		21"	55.1
17	12"	1,000		23"	660
18-1	11"	400		21"	133
18-2	18"	100		37"	16.5
19	19"	20		38"	3.86
20	12"	500		24"	65.5
21	12"	1,000		24"	98.3
22	11"	1,000		22"	81.0
23	12"	<1,000		23"	8.88
23½	12"	<1,000		24"	17.9
24	11"	<1,000		22"	491
25	9"	1,400		18"	17.7
26	11"	<1,000		21"	1.86
27	12"	<1,000		24"	10.3
28	12"	1,000		23	4.79
29	12"	1,000		24"	3.21
30	9"	400		18"	8.08
31	11"	300		22"	16.1
32	12"	250		24"	7.57
33	10"	150		20"	24.4
34	12"	100		24"	9.94

Note: Samples collected by NL Industries, Inc., analyses conducted by Century Environmental Labs, Inc. Thorofare, NJ

Table 3
Pedricktown RI/FS
Analytical Program

Sample Matrix	Lab Sieve ⁽¹⁾	Digestion	Filtration	Analytical Series ⁽²⁾								
				A	B	C	D	E	F	G	H	I
Soil	140	140	-	140	14	-	-	-	-	-	-	-
Slag	3	3	-	3	-	3	-	-	-	-	-	-
Equipment Residue	10	10	-	10	(3)	-	-	-	-	-	-	-
Containerized Solids	25	25	-	25	(3)	-	-	-	-	-	-	-
Containerized Liquids ⁽⁴⁾	-	-	-	20	-	-	20	20	-	-	4	-
Surface Water												
- Round 1 Water	-	-	-	11	1	-	11	-	-	-	-	-
- Round 2 Water	-	-	-	11	1	-	11	-	-	-	-	-
- Sediment	-	11	-	11	1	-	-	-	-	-	-	-
Marsh Sediment	-	8	-	8	-	-	-	-	-	-	-	-
Groundwater												
- Water Table Aquifer												
Round 1	-	-	24	-	-	-	-	-	24	3 ⁽⁵⁾	-	- ⁽⁶⁾
Round 2	-	-	24	-	-	-	-	-	24	-	-	3 ⁽⁶⁾
- 1st Confined Aquifer												
Round 1	-	-	4	-	-	-	-	-	4	1	-	-
Round 2	-	-	4	-	-	-	-	-	4	1	-	-
- Off-site												
Round 1	-	-	-	-	-	-	-	-	9	-	-	-
Round 2	-	-	-	-	-	-	-	-	9	-	-	-

Notes:

- (1) - Lab sieving indicates that soil samples will be sieved through a sixteen mesh stainless steel sieve after drying (8 hrs. at 100 C, or until dry), prior to analysis. Slag samples will be crushed and sieved through a 9.5 mm standard sieve in the laboratory prior to analysis.
- (2) - A indicates total lead.
B indicates antimony, arsenic, cadmium, chromium, copper, selenium, tin, and zinc.
C indicates EP Toxic metals.
D indicates pH.
E indicates TOC.
F indicates antimony, arsenic, cadmium, chromium, copper, lead, selenium, radium, gross alpha and beta, sulfate, chlorides, pH (field), conductivity (field), TOC, and TOH.
G indicates cyanide and priority pollutant metals.
H indicates TOH, gross alpha and gross beta.
I indicates priority pollutant organic chemicals.
- (3) - Total metal analysis will be conducted on unknown samples.
- (4) - Actual numbers of samples will be determined in the field, as discussed in section 6.01.2. For estimating purposes, it is anticipated that 20 samples will be obtained.
- (5) - Any of the parameters identified in any of these three samples within 75% of Primary Drinking Water Standards will be added to all well samples in subsequent sampling and analysis.
- (6) - As determined from TOC and TOH results of first round sampling.

Figures

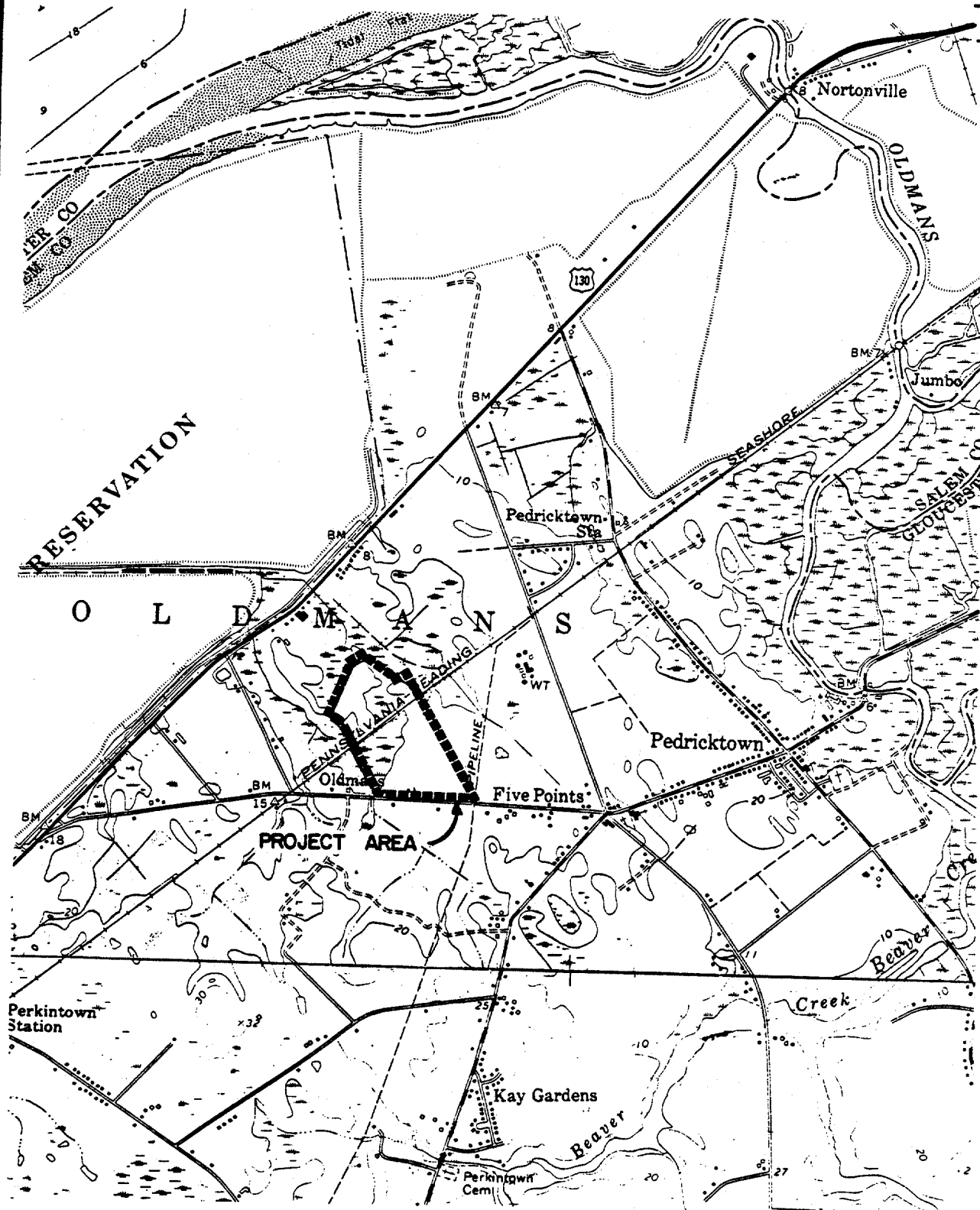


O'BRIEN & GERE

NLI 001 0339

NL INDUSTRIES, INC. PEDRICKTOWN, NEW JERSEY

PROJECT LOCATION MAP



NOTE: Map adapted from U.S.G.S. Marcus Hook, Pa. - Penns Grove, N.J. Quadrangles

EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 54369

DOC TITLE/SUBJECT:

FIGURE 2
SOIL SAMPLE
LOCATION MAP

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AT THE

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290 BROADWAY, 18TH FLOOR
NEW YORK, NY 10007

EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 54369

DOC TITLE/SUBJECT:
FIGURE 3

SITE MAP

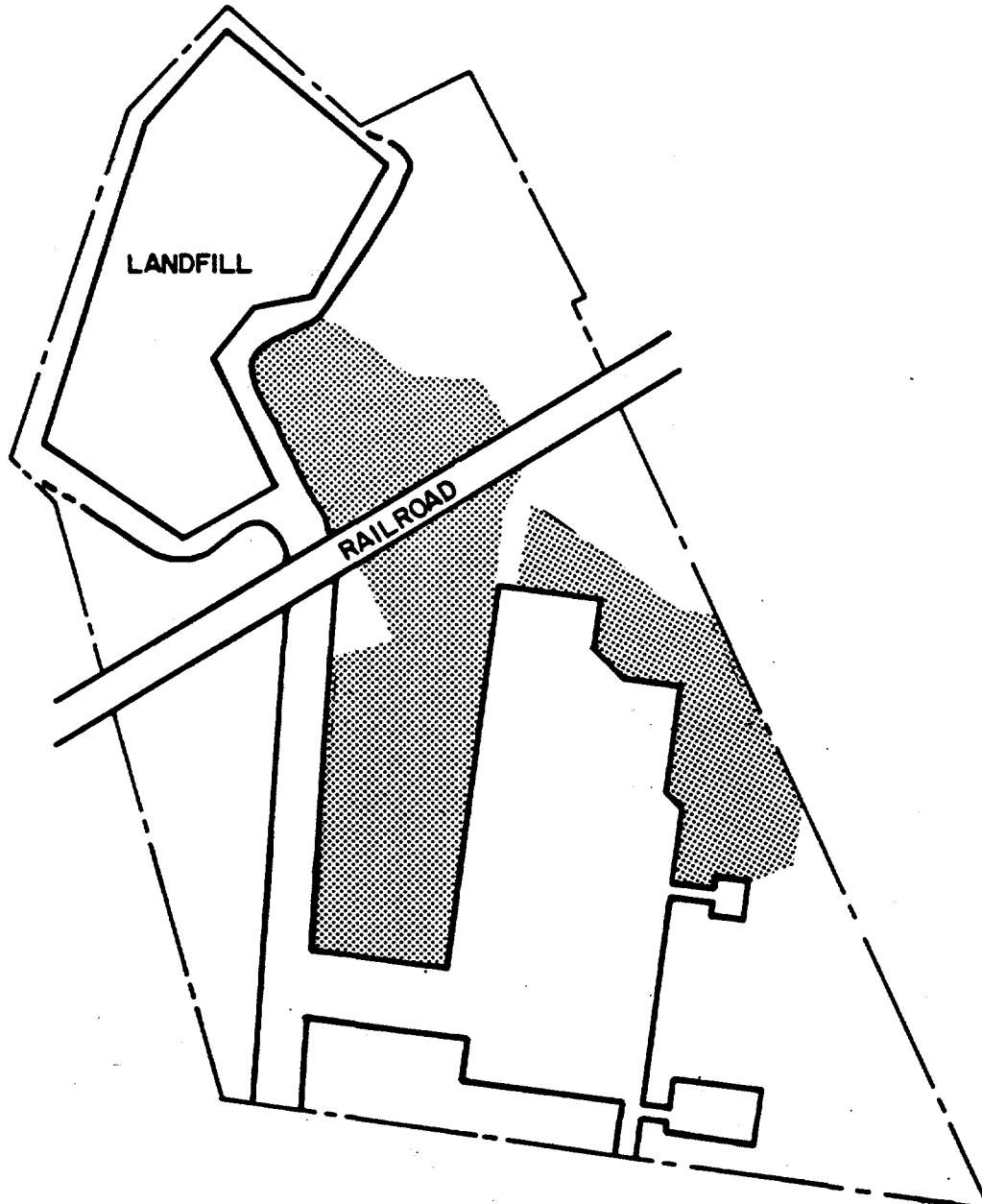
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NEW YORK, NY 10007

NL INDUSTRIES, INC.
PEDRICKTOWN, NEW JERSEY

SOIL REPLACEMENT AREA

SCALE: 1" = 300'



NLI 001 0343

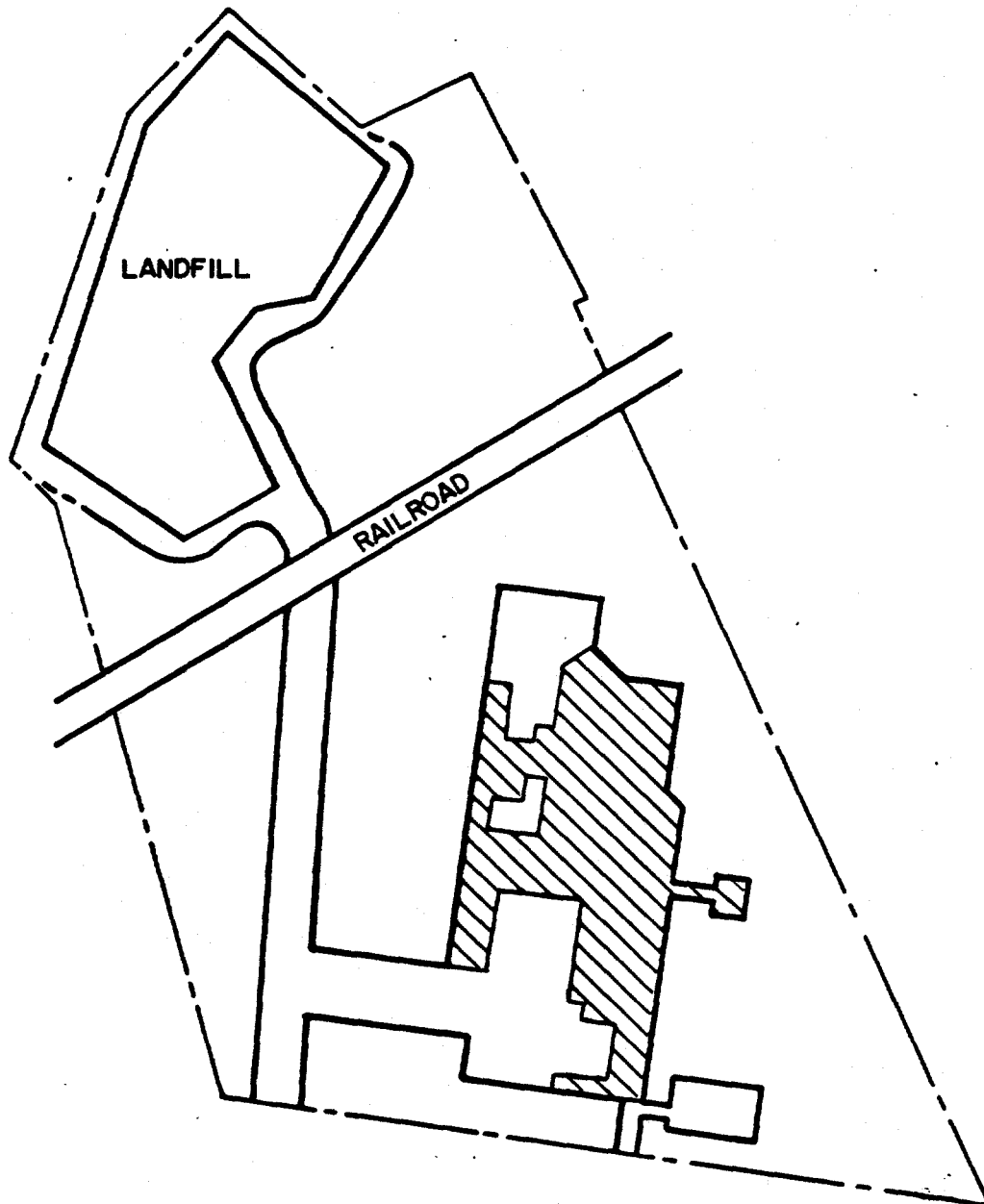
 - SOIL REPLACEMENT AREA

FIGURE 5

NL INDUSTRIES, INC.
PEDRICKTOWN, NEW JERSEY

PAVEMENT CLEANING ZONE

SCALE: 1" = 300'



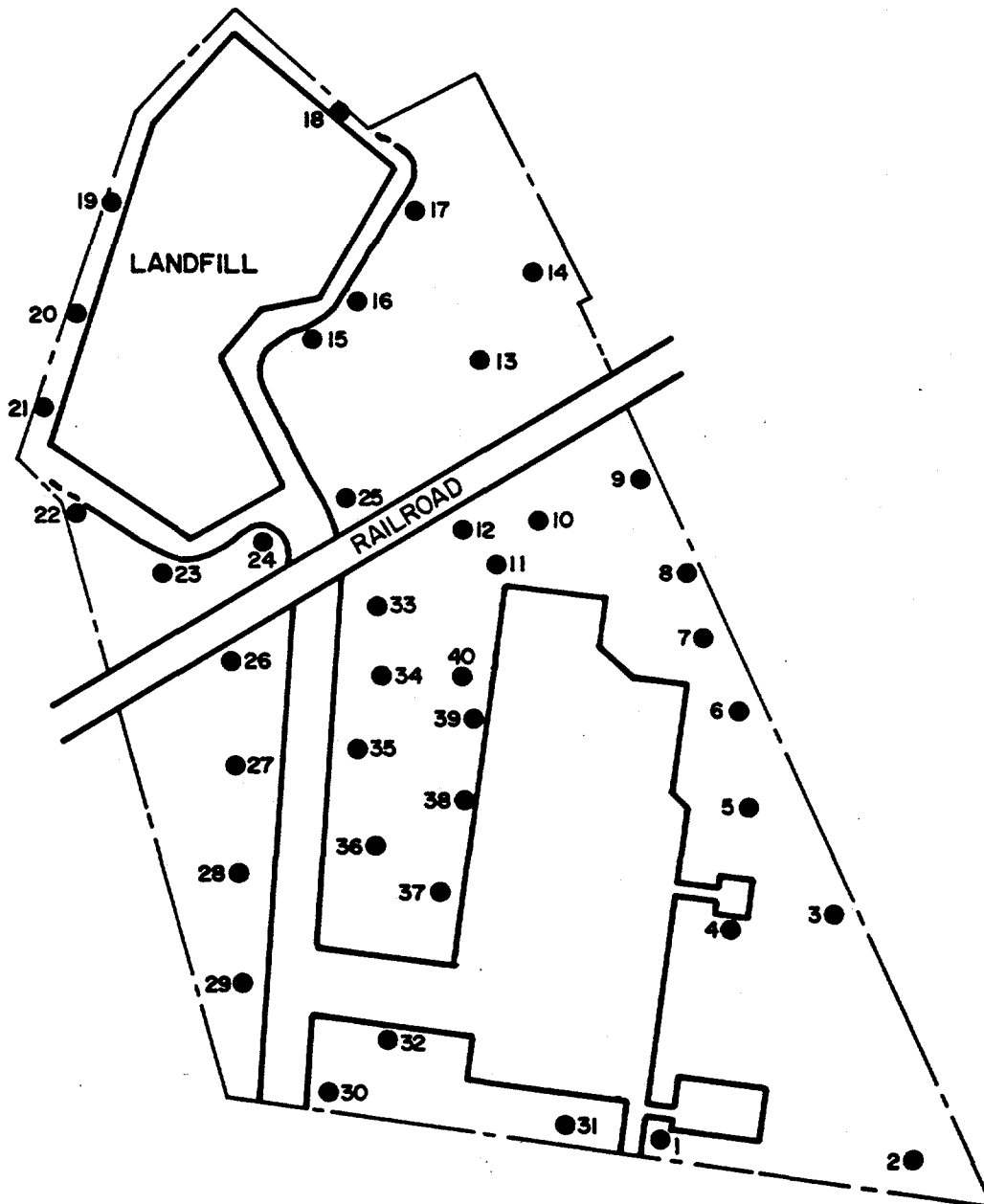
//// - PAVEMENT CLEANING ZONE

FIGURE 6

NL INDUSTRIES, INC. PEDRICKTOWN, NEW JERSEY

SOIL SAMPLING LOCATIONS
(1980)

SCALE: 1" = 300'



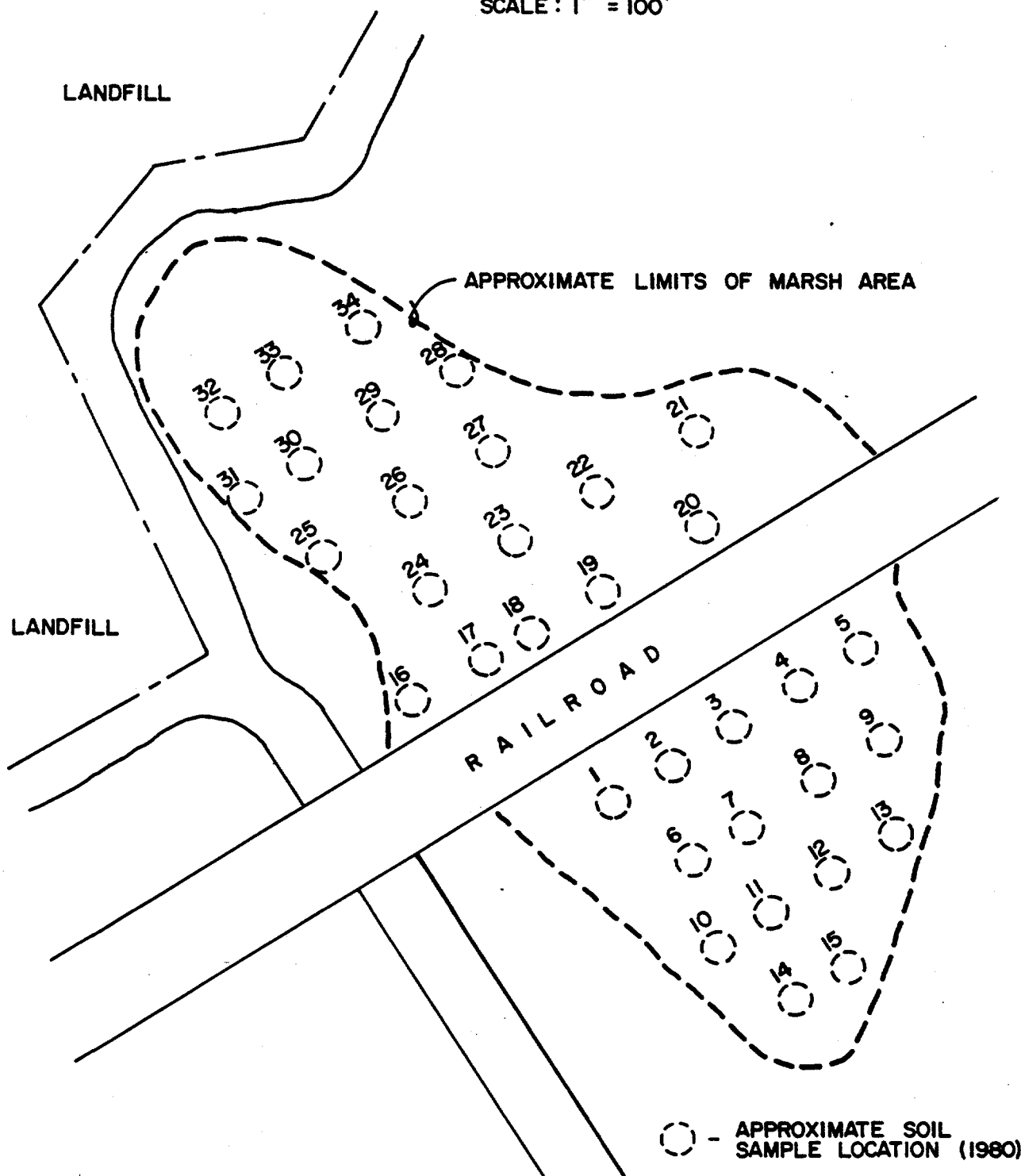
● - SAMPLE LOCATION

NL INDUSTRIES, INC. PEDRICKTOWN, NEW JERSEY

MARSH AREA SOIL SAMPLE LOCATIONS (1980)



SCALE : 1" = 100'



EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 54369

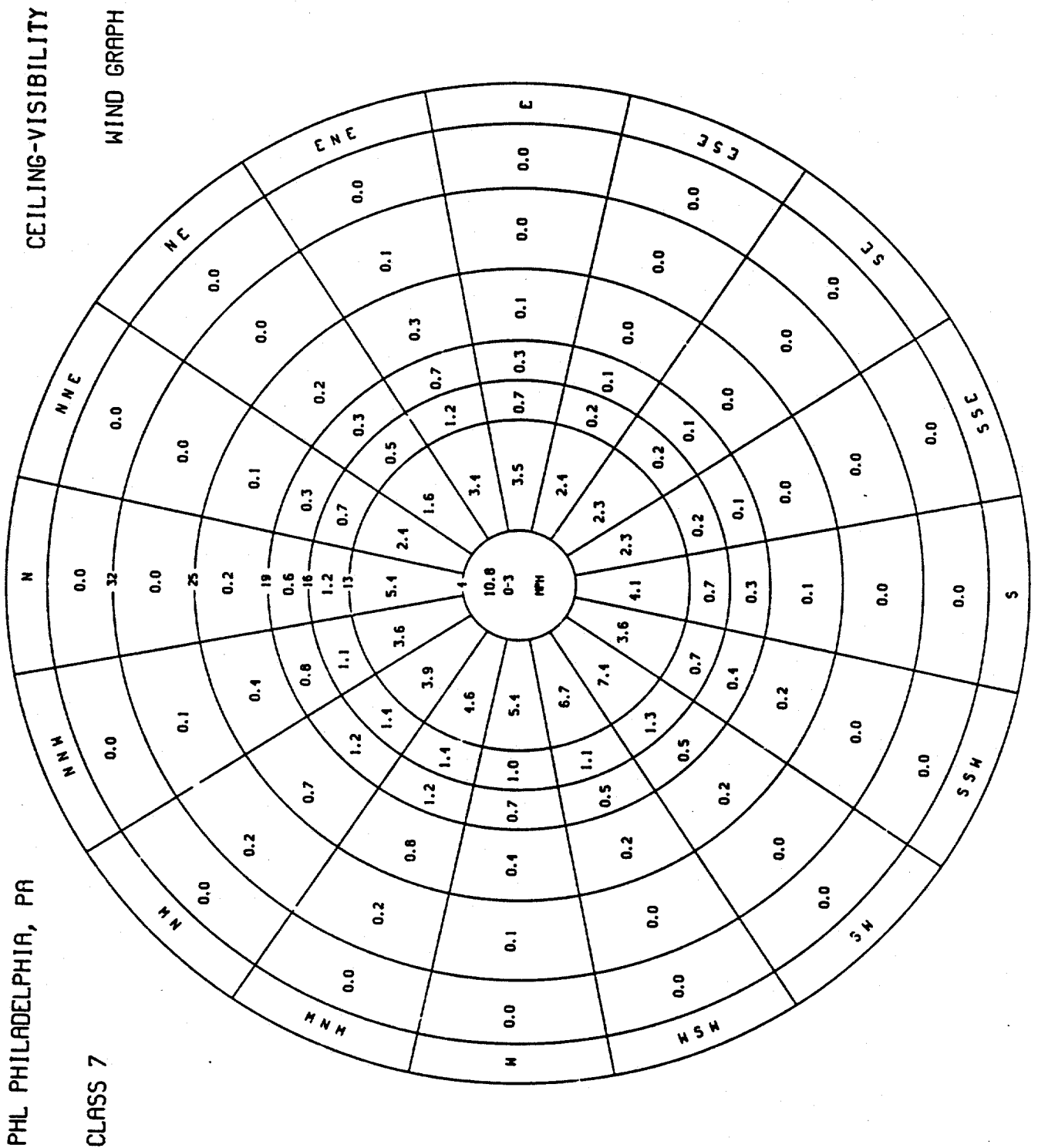
DOC TITLE/SUBJECT:

WELL LOCATION MAP

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NEW YORK, NY 10007

FIGURE 9 - WIND ROSE
FOR PHILADELPHIA, PA



Exhibits



RIEN & GERE

NLI 001 0349

EXHIBIT A
LANDFILL CLOSURE INFORMATION



State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WASTE MANAGEMENT
32 E. Hanover St., CN 027, Trenton, N.J. 08625

DR. MARWAN M. SADAT
DIRECTOR

October 20, 1983

LINO F. PEREIRA
DEPUTY DIRECTOR

Mr. Stephen W. Holt
N. L. Industries, Inc.
Penns Grove - Pedricktown Road
Pedricktown, New Jersey 08067

RE: N. L. Industries, Inc., Oldmans Township, Salem County, New Jersey
Facility Registration Number 1706C

Dear Mr. Holt:

The Bureau of Hazardous Waste Engineering has reviewed the submittals from Roy F. Weston, Inc. made on December 15, 1982, March 24, 1983 and August 16, 1983 in behalf of N. L. Industries, Inc. in reference to the Closure and Post-Closure plans for a hazardous waste landfill located at the former N. L. Industries, Inc. Pedricktown plant premises. This submittal was made in response to items 2(d) and 3 of the Administrative Consent Order signed by N. L. Industries, Inc. and the Department on October 6, 1982 regarding the final closure of the existing hazardous waste landfill.

The Bureau of Hazardous Waste Engineering has found said submittals in conformance with regulatory standards set forth in Subchapters 9 and 11 of N.J.A.C. 7:26 and hereby approves the closure and post-closure plans subject to compliance with the following conditions:

- 1) The closure shall follow specifications of the engineering designs and narrative prepared by Roy F. Weston, Incorporated; specifically: the engineering report prepared by James H. Dougherty, P.E. and Amir A. Metry, P.E. dated December 13, 1982, the engineering report in response to NJDEP comments prepared by Michael H. Corbin, P.E., dated March 22, 1983, drawing sheet No. 5 - Rev. No. 5 prepared by Roy F. Weston, Inc. dated June 24, 1977, drawing sheet No. 6 - Rev. No. 3 prepared by Roy F. Weston, Inc. dated September 11, 1981, drawing sheet No. 7 - Rev. No. 3 prepared by Roy F. Weston, Inc. dated September 11, 1981 and drawing sheet No. 8 - Rev. No. 1 prepared by Roy F. Weston, Inc. dated September 11, 1981, except as modified herein. #1
#2
#3
- 2) The landfill shall be graded in accordance with the narratives prepared by Roy F. Weston, Inc. dated December 13, 1982 and as shown on drawing sheet No. 5 - Rev. No. 5 dated June 24, 1977, prepared by Roy F. Weston, Inc. #4

NSNJ PEDRICKTOWN SITE
CHRONOLOGY OF EVENTS RELATIVE TO ON-SITE LANDFILL

August 1982	Plant Soils and Marsh Soils Cleanup Activities Started.
December 1982	Started Placement of Landfill Clay Cap to Reduce Leachate Generation.
August 1983	Clay Cap Completed and Tested August 10, 1983.
October 20, 1983	Closure Plan Approved by NJDEP.
December 15, 1983	Closure Certified by NL Industries, Inc. and Roy F. Weston, Inc.
December 22, 1983	Landfill Maintenance Operations Transferred to NSNJ.
May 29, 1984	NL Repairs Winter Damage to Landfill Cover.
June 15, 1984	National Bank of Georgia Terminates Final Employee.
June 18, 1984	NL Voluntarily Enters Site to Maintain Landfill.
January 25, 1985	Phase B - Automatic Operation Commences.
February 20, 1985	Phase A - Automatic Operation Commences.

October 20, 1983

- 3) After grading, a clay cap of a minimum thickness of six (6) inches and maximum permeability of 1×10^{-7} cm/sec shall be placed over the entire landfill surface and compacted to 90% minimum as per ASTM D-1557 Method C. This item is expected to be completed before October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon implementation. #5

- 4) A final cover system, designed to intercept and divert any infiltration away from the clay cap layer, shall be placed on top of the clay cap. The bottom layer of this cover system shall consist of a 6-inch layer of a coarse to fine sand with a permeability of 1×10^{-2} to 1×10^{-3} cm/sec. Six inches of clean earth shall be placed over this bottom layer followed by six inches of top soil. These soil layers shall serve to support a vegetative cover. #6

The final elevation of the landfill shall be approximately 40 feet above MSL (mean sea level). The final landfill contours and drainage plan shall be as shown on drawing sheet No. 6 - Rev. No. 3 prepared by Roy F. Weston, Inc., dated September 11, 1981. The final side slopes shall be as described in the narratives prepared by Michael H. Corbin, P.E. (design clarification report) dated August 11, 1983. The side slopes on the western and southern boundaries of the landfill shall not be steeper than 2:1 (horizontal to vertical), ranging from approximately 4:1 to 2 1/2:1. Other slopes on the eastern and northern boundaries shall be 2:1 or less steep. This item is expected to be completed by October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon implementation.

- 5) The top of the landfill shall be graded at a minimum slope of 1 percent to provide positive drainage.

Surface run-off in Phase A shall be directed to a corrugated metal half-section pipe drain down the side slope as shown on drawing sheet No. 6 - Rev. No. 3 prepared by Roy F. Weston, Inc. and dated September 11, 1981. Run-off shall then be conveyed by storm sewer or stone-lined channels to existing waterways. Surface run-off from Phase B shall be directed to a stone-lined swale down the side slope as shown on said drawing sheet, and then across the perimeter road to surface discharge. Diversions shall be constructed around the leachate sumps' riser pipes pumping pads. This item is expected to be completed by October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon implementation. #7

- 6) A drainage swale shall be constructed along the landfill perimeter to collect run-off from the side slopes. This storm-water shall be dissipated across the perimeter road by stone swales at the natural low-points. Design details for this drainage system shall be as shown on drawing sheet No. 8 - Rev. No. 1 prepared by Roy F. Weston, Inc. dated September 11, 1981. Completion of this item is expected by October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon implementation.

October 20, 1983

7) The top soil shall be stabilized to prevent erosion by establishing a vegetative cover. This vegetative cover shall be established by spreading a type A seed mixture, and shall be mulched with straw, in accordance with the New Jersey Department of Transportation (N.J.D.O.T.) specifications. The side slopes shall be seeded with N.J.D.O.T. type E seed mixture, which includes crown vetch, and shall be mulched to minimize the potential of soil erosion until vegetation is established. Completion of this item is expected by October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon implementation.

8) A permanent fence shall be installed around the landfill and all monitoring wells. The fence shall be at least 8-feet high and topped with three strands of barbed wire. Vehicle access gates with locks shall be installed at the landfill ~~entrance road and directly north of the leachate storage tank.~~ Completion of this item is expected by October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon completion. #8

9) Liquids which have accumulated in the leak detection sumps of both Phase A and Phase B shall be removed, to restore these sumps to effective monitoring points for assessment of the integrity of the primary (upper) landfill liner. Completion of this item should be undertaken by October 30, 1983 and must be certified by a New Jersey Licensed Professional Engineer upon completion. #9

10) The owner of the property on which a disposal facility is located shall record, in accordance with State Law, a notation on the deed to the facility property, or some other instrument which is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that: #10

- a) The land has been used to manage hazardous waste.
- b) Post-closure use of property on or in which hazardous waste remains after closure shall never be allowed to disturb the integrity of the final cover, liners, or any other components of any containment system, or the function of the facility's monitoring systems, unless the owner or operator can demonstrate to the Department by petition that the disturbance:
 - i) Is necessary to the proposed use of the property, and will not increase the potential hazard to human health or the environment; or
 - ii) Is necessary to reduce a threat to human health or the environment.
- c) The survey plat and record of the type, location, and quantity of hazardous waste disposed of within each cell or area of the facility required in paragraph 12 of this approval have been filed with the local zoning authority or the authority with jurisdiction over local land use and the Department.

October 20, 1983

- NAN
- 11) If at any time the owner or operator or any subsequent owner of land upon which a hazardous waste facility is located removes the waste and waste residues, the liner, if any, and all contaminated underlying and surrounding soil, the owner or operator may add a notation to the deed or instrument indicating the removal of the waste.
- 12) Within 90 days after closure is completed, the owner or operator of a disposal facility shall submit to the local land authority and to the Department a survey plat indicating the location and dimension of landfill cells or other disposal areas with respect to permanently surveyed benchmarks. This plat shall be prepared and certified by a professional land surveyor. The plat filed with the local land authority shall contain a note, prominently displayed which states the owner's or operator's obligation to restrict disturbance of the site as specified in paragraph 10b of this approval. In addition, the owner or operator shall submit to the Department and to the local land authority a record of the type, location, and quantity of hazardous wastes disposed of within each cell or area of the facility.
- 13) Within 90 days after final closure, NL Industries shall submit to the Bureau of Hazardous Waste Engineering a final topographic map of the landfill. This item must be prepared by a New Jersey Licensed Land Surveyor.
- 14) Final closure shall not be deemed complete until all New Jersey licensed Professional Engineer's certifications and other submittals required by this approval have been submitted to the Department and approved, and an acceptable post-closure care plan has been approved by the Department. In the interim, NL Industries, Inc., shall continue to comply with all monitoring and reporting requirements of N.J.A.C. 7:26-1 et seq. and the Engineering Design Approval of record for the subject landfill. #11
- 15) NL Industries, Inc. shall establish within thirty (30) days from the date of this approval, compliance with the liability requirements of N.J.A.C. 7:26-9.13, including the submission to the Department of originally signed duplicates of the insurance policies for sudden and accidental occurrences required by N.J.A.C. 7:26-9.13(b) and for non-sudden and accidental occurrences required by N.J.A.C. 7:26-9.13(c). #12
January 26
- 16) The New Jersey Licensed Professional Engineer's certifications required by this approval shall be submitted to the Department within seven (20) days after the item being certified has been completed, or within seven (20) days of the date of this approval, if the item has already been completed. #13
January 27

Stephen W. Holt

-5-

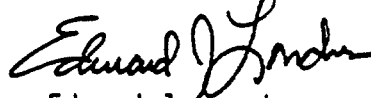
October 20, 1983

These certifications, along with all submittals to the Department to be made pursuant to conditions 12, 13, 14, and 15 of this approval shall be addressed to:

Frank Coolick, Chief
Bureau of Hazardous Waste Engineering
Division of Waste Management
New Jersey Department of Environmental Protection
CN028
Trenton, New Jersey 08625

If you have any questions regarding these matters, please call the Bureau of Hazardous Waste Engineering at (609) 292-9880.

Very truly yours,



Edward J. Londres
Assistant Director
Engineering

EP8/EP10/jb

NLI 001 0356

TYPICAL SECTION
PERIMETER SWALE

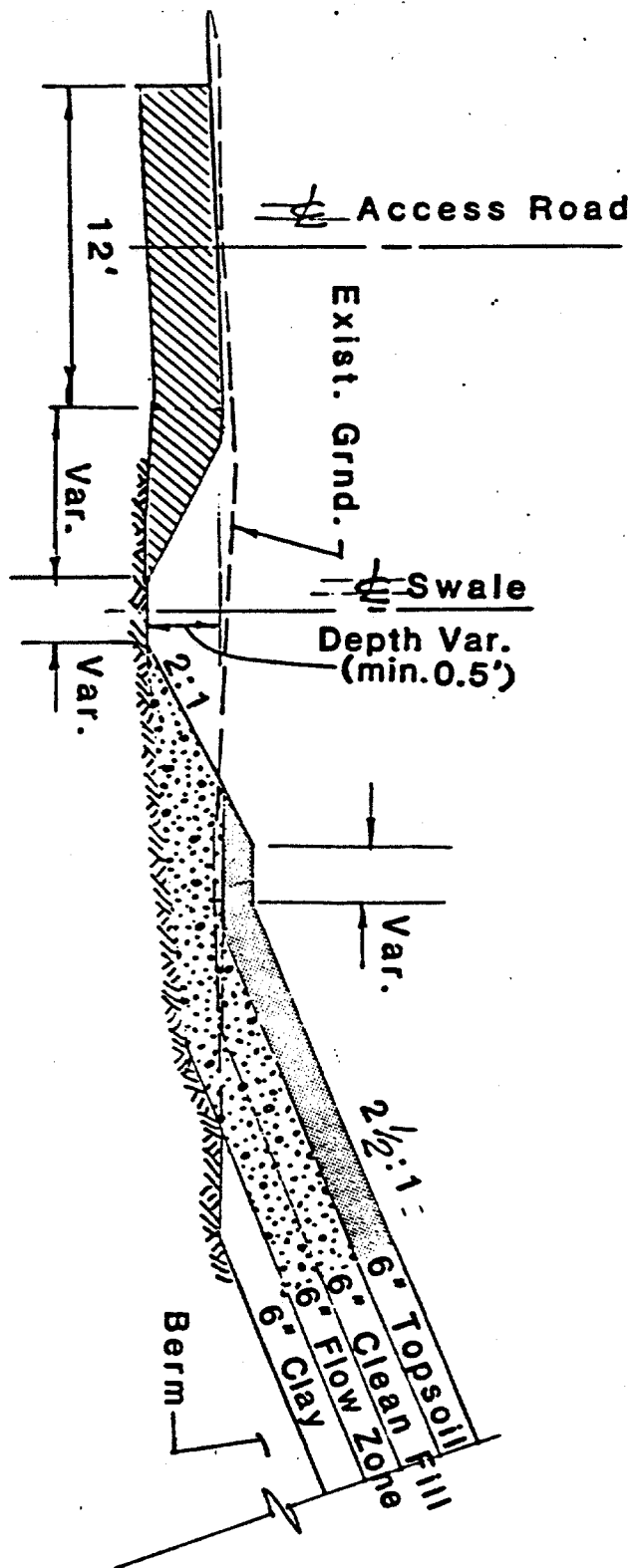


FIG. 2

DETAILS
PERIMETER SWALE

NL Industries, Inc.

Pedricktown Plant

Salem Co. New Jersey

ROY F. WESTON, INC.



DRAWN <i>R.E.B.</i>	DATE 7-13-83	DES. ENG.	DATE	W. O. NO.
CHECKED		APPROVED		DWG. NO.



WESTON WAY
WEST CHESTER, PA. 19380
PHONE (215) 692-3030
TELEX: 83-5348

13 December 1983

Mr. Stephen W. Holt
N.L. Industries, Inc.
Penns Grove-Pedricktown Road
Pedricktown, NJ 08067

W.O.#0793-08-04

Reference: Landfill Closure Certification
N.L. Industries, Inc.
Pedricktown, New Jersey
Facility No. 1706C
EPA I.D.#NJDO61843249

Dear Steve:

This is to certify that the closure of the landfill referenced above has been completed by Haas Construction Inc. (prime contractor) in accordance with the following closure plan documents:

1. Closure/Post-Closure Plan dated 12/13/82, submitted 12/15/82, prepared by WESTON.
2. Addendum report to Closure/Post-Closure Plan dated 3/22/83, submitted 3/24/83, prepared by WESTON in response to NJDEP comments on 12/13/82 Closure/Post-Closure Plan.
3. Design clarification letter report dated 8/11/83, submitted 8/16/83, prepared by WESTON. and
4. Engineering Design Approval (NJDEP document) dated 4/5/78.

In accordance with the October 27, 1983 meeting between N.L. Industries, WESTON and NJDEP, WESTON provides the following certification for the landfill closure work:

1. A clay cap of a minimum thickness of 6 inches with clay having a maximum permeability of 1×10^{-7} centimeters per second has been placed over the entire landfill surface and has been compacted to at least 90% as determined by the ASTM D698 method. The attached (Attachment #1) certified laboratory results



Mr. Stephen W. Holt
N.L. Industries, Inc.

-2-

13 December 1983

provided by the Contractor (U.F.&S Reference No. 4617) provides the results of the permeability testing of nine clay samples and indicates thickness of the clay cap at these locations.

2. A final cover system consisting of a gravelly sand and sand flow/fill zone and a 6 inch top soil layer was installed and the flow zone meets or exceeds the permeability standards set forth in the closure plan documents. The certified analysis (provided by the Contractor, U.F.&S Reference No. 4580) of the cover system materials is included as Attachment #2.
3. The final elevation of the landfill does not exceed 45 feet above mean sea level.
4. The side slopes of the landfill are within the limits established by the closure plan documents.
5. The final gradient of the completed final cover on the top area of the landfill was measured to be a minimum of 1%.
6. Drainage structures including retaining walls around the leachate collection sumps and slope drains were installed and completed in accordance with the closure plan documents.
7. Seeding of the final cover was performed and completed in accordance with the specifications. The application rates were established by the Contractor and provided in Attachment #3 (U.F.&S Reference No. 4669-A). The slopes were planted with 100 lbs. of annual rye and 25 lbs. of crown vetch per acre. The top was planted with 50 lbs. of perennial rye, 30 lbs. of Kentucky 31 and 30 lbs. of chewing fescue per acre. Vegetative cover was established exclusive of some areas which may require reseeding in the spring under the post closure plan.
8. An 8 foot high chain link security fence has been installed surrounding the landfill.
9. Attachment #4, Memorandum from R. Buss to M. Corbin dated November 18, 1983 details the procedure for sounding of the liquid levels in the monitoring sumps in accordance with our meeting of October 27, 1983 and



Mr. Stephen W. Holt
N.L. Industries, Inc.

-3-

13 December 1983

provides the initial certified sounding measurements from the top of the riser pipes to the liquid levels as recorded on November 18, 1983. A sounding measurement of 28.3 feet was recorded in Sump A and a sounding measurement of 29.9 feet recorded in Sump B.

If WESTON can provide additional information on the closure work performed at the Pedricktown Plant Landfill please contact the undersigned.

Very truly yours,

ROY F. WESTON, INC.

A handwritten signature in dark ink, appearing to read "Michael H. Corbin".

Michael H. Corbin, P.E.
Project Manager

A handwritten signature in dark ink, appearing to read "James H. Dougherty".

James H. Dougherty, P.E.
Vice President

MHC/JHD/snh

Attachments

cc: Mr. Dean Ervin
Jeffrey Jacobs, Esq.

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike
Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, Manager

Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Company
PROJECT: N.L. Industries
TEST/INSPECTION REQUIRED: Clay Cover Laboratory Tests
LOCATION: N.L. Industries, Pedricktown, N. J.
DATE Sampled: 8/10/83
UF&S REF. NO.: 4617

TEST/INSPECTION RESULTS

All tests and inspections performed on the above landfill were satisfactory and met or exceeded project qualifications.

Below are the results of the most recent tests.

<u>Sample #</u>	<u>Permeability (cm/sec)</u>	<u>Depth of Clay</u>	<u>Location</u>
1	4.68×10^{-8}	12.0"	90' Upgradient apron fr. A. Headwall
2	2.67×10^{-8}	7.0"	40' S. of N. corner Phase A
3	3.55×10^{-8}	17½"	Center gradient edge slope div. 30' fr.
4	2.07×10^{-8}	14½"	Gradient Div. on E. edge of side slope
5	4.02×10^{-8}	8½"	40' E. of W. corner Phase B
6	2.61×10^{-8}	14½"	60' Upgradient fr. B. Headwall
7	3.99×10^{-8}	8 3/4"	20' Upgradient fr. B sump wall
8	4.15×10^{-8}	7½"	20' Upgradient fr. A sump wall
9	4.70×10^{-8}	19 3/4"	20' Upgradient fr. B gas monitoring Well #.

Proctor Per A.A. - S.H.T.O. (T 180-72)

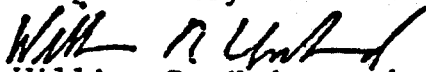
Permeability Per, "Falling Head Permeability Test" by K.H. Head in,
"Manual of Soil Laboratory Testing, Volume 2. November 1981"

LABORATORY TEST RESULTSProctor Moisture Density Relationship

Test #1 114.6 PLF

Test #2 116.0 PLF

Respectfully submitted,


William R. Underwood, P.E.

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike
Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, Manager

 Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Company
 PROJECT: N.L. Industries
 REQUIREMENT: Fill Cover Analysis, Woolwich Sand & Gravel
 DATE: July 26, 1983
 UF&S REF. NO. 4580

LABORATORY ANALYSISSIEVE ANALYSIS

SIEVE SIZE	PERCENT PASSING		
	#1 Sand SAMPLE	#2 Gravel SAMPLE	#3 Top Soil SAMPLE
3/4"	100	90.0	100
1"	100	100	100
#4	100	62.0	99.3
#16	97.8	49.3	92.7
#50	29.6	9.7	42.6
#100	9.3	3.0	25.0
#200	2.9	1.2	10.0
Permeability	2.5×10^{-2}	7.5×10^{-2}	1.8×10^{-2}

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.



William R. Underwood, P.E.
 CC to Mr. M. Corbin, Weston Way
 West Chester, Pa.

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike

Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, Manager

Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Co.
PROJECT: N.L. Industries, Pedricktown, N. J.
INSPECTION REQUIRED: Topsoil & Planting Cover
DATE: Sept. 21, 1983
UF&S REF. NO.: 4669-A

REPORTPurpose

The purpose of this report is to address the planting and maintenance of the final cover of the solid waste landfill at the above location.

Planting

The tops and slopes of the above landfill were planted with mixture of fertilizer and seeds as follows:

The slopes were planted with 100 pounds of annual rye and 25 pounds of crown vetch per acre.

The top was planted with 50 pounds of perennial rye, 30 pounds of K-31 and 30 pounds of chewing fescue per acre.

Fertilizing

The entire cover was fertilized with 300 pounds of 10-20-10 fertilizer per acre and one thousand pounds of lime per acre.

Maintenance

After initial successful growth of the above, fertilizer, as required may be added during March of 1984.

No cuttings of the above plantings should be performed.

Any erosion of the slopes should be repaired as soon as possible.

Qualifications

The above information is per Lewis Colameco of Lewis Colameco & Sons of Pennsylvania (215-647-4977). Any inquiries should be directed to him.

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.


William R. Underwood, P.E.

NLI 001 0363



inter-office memorandum

TO: M. Corbin

DATE: 18 November 1983

FROM:


R. Buss

SUBJECT: N. L. INDUSTRIES
Pedricktown, N.J. Landfill Facility
Secondary Liner Leak Detection System Monitoring
Sumps A & B

W. O. No.: 0793-08-04

Steve Holt and I established a liquid level monitoring procedure and obtained the initial (certified) "sounding" measurements to liquid levels in secondary sumps A & B today. (See sketch and table of measurements included herein).

After reviewing and testing several methods, we established the following procedure for obtaining measurements to accurately monitor the liquid levels in the secondary sumps.

Procedure as follows:

1. Confirm that the 1½" PVC suction line (retained in place for secondary sump pumping) is laying on the invert of the 10" C.M.P.
2. Insert the 1/2" copper (collapsible) "sounding" rod into the 1½" PVC line as far as the wire stop at the end of the 1½" PVC line.
3. Using chalk (or other temporary marking material) carefully mark the 1/2" copper "sounding" rod at a point coinciding with the end of the 10" C.M.P.
4. Withdraw the copper "sounding" rod and measure the dimension along the rod from the point marked as described in 3 above, to the *beginning of the wetted area of the rod.

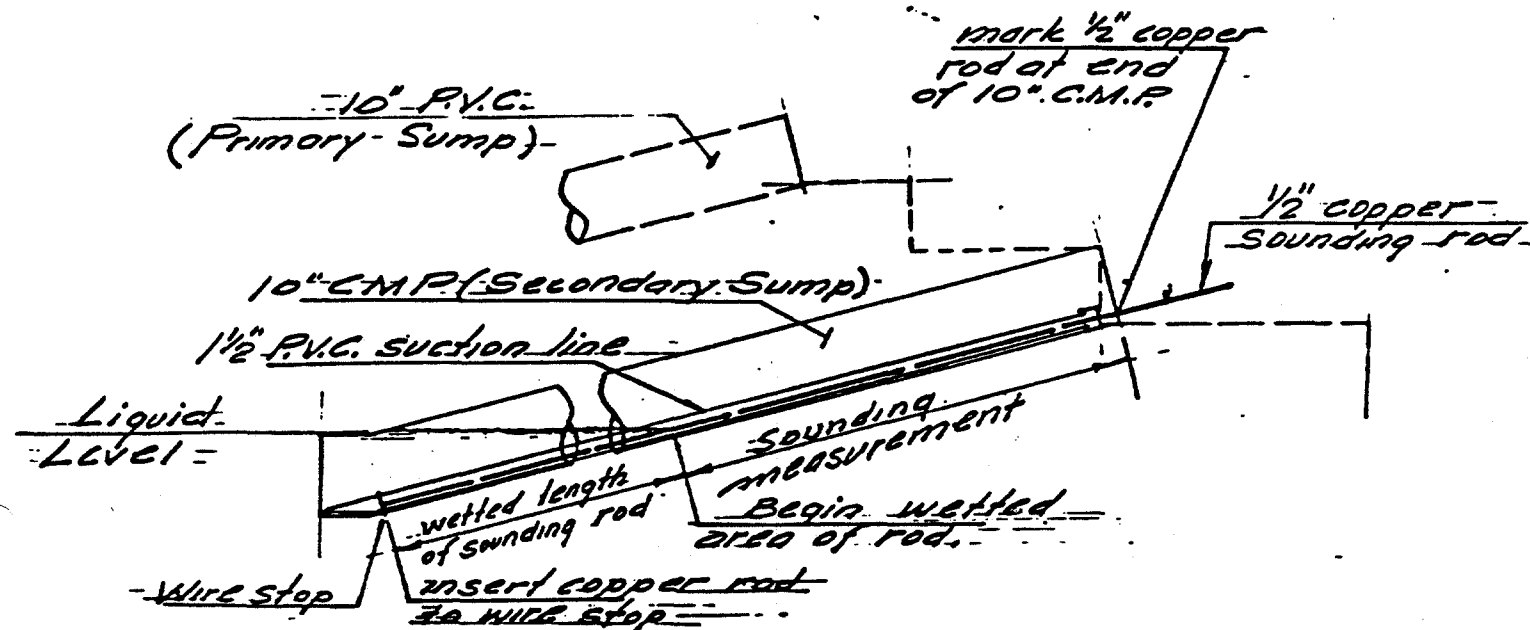
* The measurement described in 4 above must be taken promptly (particularly in dry/windy conditions) due to evaporation of moisture from the rod surface. To maximize clarity of the beginning of the wetted area, the surface of the "sounding" rod should be "chalked" in the approximate area of anticipated liquid level prior to insertion.

NLI 001 0364

18 November 1983

The following table is a record of the initial "sounding" measurements obtained at secondary sumps A & B today in accordance with the procedure described above:

<u>Sump</u>	<u>Sounding Measurement</u>	<u>Date</u>	<u>Time</u>
A	28.26'	November 18, 1983	1:30 p.m.
B	29.90'	November 18, 1983	1:45 p.m.



SKETCH SHOWING DETAILS
OF SECONDARY SUMP SOUNDINGS

The procedure described above is relatively simple and will insure maximum consistency in monitoring the liquid levels.

It is my understanding that the secondary sumps will be monitored regularly, every Monday A.M., prior to commencement of leachate pumping from the primary sumps for that week.

If you have any questions or need additional information, don't hesitate to call.

Dick

NL

RECEIVED

DEC 15 3 00 PM '83

DEPARTMENT OF
WASTE MANAGEMENT

December 14, 1983

Mr. Edward J. Londres
Assistant Director - Engineering
Division of Waste Management
32 E. Hanover Street
Trenton, NJ 08625

Re: Landfill Closure Certification
NL Industries, Inc.
Pedricktown, New Jersey
Facility No. 1706 C (EPA I.D. No.: NJD0618432)

Dear Mr. Londres:

Enclosed are: (i) the certification of closure of the referenced facility by Roy F. Westin, Inc., a licensed New Jersey engineer, and (ii) a topographic as built survey prepared by Albert A. Fralinger, Jr., P.A., a licensed New Jersey surveyor. Based on the enclosed certification and survey, NL certifies to NJDEP that the referenced landfill was closed in accordance with the specifications of the closure plan approved by NJDEP as set forth in the following documents:

- A. The Engineering Design Approval, dated April 5, 1978 as amended.
- B. Closure/Post Closure Plans submitted December 15, 1982.
- C. Addendum to the Closure/Post Closure plans submitted March 24, 1983.
- D. Design Clarification report submitted August 16, 1983.

All documents, plans and drawings required by NSNJ to discharge its post-closure obligations will be provided by NL to NSNJ. In addition, NSNJ has been present during closure of the landfill and has been provided with information on an ongoing basis to provide for a smooth transition.

DWE10
NL Industries, Inc.
1230 Avenue of the Americas, New York, N.Y. 10020

NLI 001 0366

December 14, 1983

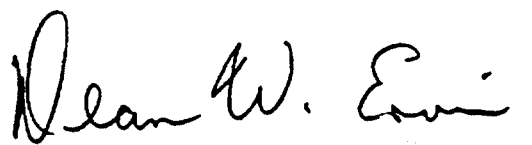
Page 2

The landfill, as noted above, has been closed in accordance with the specified documents. Since closure, NL Industries has been maintaining the facility in accordance with Post Closure plans submitted December 15, 1982. Post closure activities, including maintenance and monitoring of the landfill's condition, are now the responsibility of National Smelting of New Jersey (NSNJ) as described in Amendment to Administrative Consent Order dated February 7, 1983. This responsibility specifically includes annual analysis of top soils, reseeding and fertilization of the top cover as recommended by the County Agricultural Agent, pumping of leachate, and the filing of reports as required by State and Federal agencies.

Respectfully submitted,



Steven W. Holt
Project Manager



Dean W. Ervin
Dean W. Ervin
Director, Metals Operations

DWE/rw

enclosure

DWE10

NLI 001 0367



WESTON WAY
WEST CHESTER, PA. 19380
PHONE: (215) 692-3030
TELEX: 83-5348

13 December 1983

Mr. Edward J. Londres
Assistant Director-Engineering
Division of Waste Management
N.J. Department of Environmental Protection
32 E. Hanover Street CN027
Trenton, NJ 08625

Reference: Landfill Closure Certification
N.L. Industries, Inc.
Pedricktown, New Jersey
Facility No. 1706C
EPA I.D.#NJDO61843249

Dear Mr. Londres:

This is to certify that the closure of the landfill referenced above has been completed by Haas Construction Inc. (prime contractor) in accordance with the following closure plan documents:

1. Closure/Post-Closure Plan dated 12/13/82, submitted 12/15/82, prepared by WESTON.
2. Addendum report to Closure/Post-Closure Plan dated 3/22/83, submitted 3/24/83, prepared by WESTON in response to NJDEP comments on 12/13/82 Closure/Post-Closure Plan.
3. Design clarification letter report dated 8/11/83, submitted 8/16/83, prepared by WESTON. and
4. Engineering Design Approval (NJDEP document) dated 4/5/78.

In accordance with the October 27, 1983 meeting between N.L. Industries, WESTON and NJDEP, WESTON provides the following certification for the landfill closure work:

1. A clay cap of a minimum thickness of 6 inches with clay having a maximum permeability of 1×10^{-7} centimeters per second has been placed over the entire landfill surface and has been compacted to at least 90% as determined by the ASTM D698 method. The attached (Attachment #1) certified laboratory results

NLI 001 0368



Mr. Edward J. Londres
N.J. Department of Environmental Protection

-2-

13 December 1983

provided by the Contractor (U.F.&S Reference No. 4617) provides the results of the permeability testing of nine clay samples and indicates thickness of the clay cap at these locations.

2. A final cover system consisting of a gravelly sand and sand flow/fill zone and a 6 inch top soil layer was installed and the flow zone meets or exceeds the permeability standards set forth in the closure plan documents. The certified analysis (provided by the Contractor, U.F.&S Reference No. 4580) of the cover system materials is included as Attachment #2.
3. The final elevation of the landfill does not exceed 45 feet above mean sea level.
4. The side slopes of the landfill are within the limits established by the closure plan documents.
5. The final gradient of the completed final cover on the top area of the landfill was measured to be a minimum of 1%.
6. Drainage structures including retaining walls around the leachate collection sumps and slope drains were installed and completed in accordance with the closure plan documents.
7. Seeding of the final cover was performed and completed in accordance with the specifications. The application rates were established by the Contractor and provided in Attachment #3 (U.F.&S Reference No. 4669-A). The slopes were planted with 100 lbs. of annual rye and 25 lbs. of crown vetch per acre. The top was planted with 50 lbs. of perennial rye, 30 lbs. of Kentucky 31 and 30 lbs. of chewing fescue per acre. Vegetative cover was established exclusive of some areas which may require reseeding in the spring under the post closure plan.
8. An 8 foot high chain link security fence has been installed surrounding the landfill.
9. Attachment #4, Memorandum from R. Buss to M. Corbin dated November 18, 1983 details the procedure for sounding of the liquid levels in the monitoring sumps in accordance with our meeting of October 27, 1983 and

NLI 001 0369

WESTON

Mr. Edward J. Londres
N.J. Department of Environmental Protection

-3-

13 December 1983

provides the initial certified sounding measurements from the top of the riser pipes to the liquid levels as recorded on November 18, 1983. A sounding measurement of 28.3 feet was recorded in Sump A and a sounding measurement of 29.9 feet recorded in Sump B.

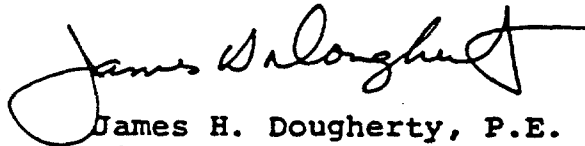
If WESTON can provide additional information on the closure work performed at the Pedricktown Plant Landfill please contact the undersigned.

Very truly yours,

ROY F. WESTON, INC.



Michael H. Corbin, P.E.
Project Manager



James H. Dougherty, P.E.
Vice President

MHC/JHD/snh

Attachments

cc: Paul Kahn, Esq.
Keith Ornsdorff, Esq.
Mr. Roger Ennis, Envir. Eng. (NJDEP)
Jeffrey Jacobs, Esq., N.L.
Mr. Dean Ervin, N.L.
✓ Mr. Stephen Holt, N.L.

NLI 001 0370

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike
Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, Ma

Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Company
PROJECT: N.L. Industries
TEST/INSPECTION REQUIRED: Clay Cover Laboratory Tests
LOCATION: N.L. Industries, Pedricktown, N. J.
DATE Sampled: 8/10/83
UF&S REF. NO.: 4617

TEST/INSPECTION RESULTS

All tests and inspections performed on the above landfill were satisfactory and met or exceeded project qualifications.

Below are the results of the most recent tests.

Sample #	Permeability (cm/sec)	Depth of Clay	Location
1	4.68×10^{-8}	12.0"	90' Upgradient apron fr. A. Headwa
2	2.67×10^{-8}	7.0"	40' S. of N. corner Phase A
3	3.55×10^{-8}	17½"	Center gradient edge slope div. 30
4	2.07×10^{-8}	14½"	Gradient Div. on E. edge of side s
5	4.02×10^{-8}	8½"	40' E. of W. corner Phase B
6	2.61×10^{-8}	14½"	60' Upgradient fr. B. Headwall
7	3.99×10^{-8}	8 3/4"	20' Upgradient fr. B sump wall
8	4.15×10^{-8}	7½"	20' Upgradient fr. A sump wall
9	4.70×10^{-8}	19 3/4"	20' Upgradient fr. B gas monitoring Well

Proctor Per A.A. - S.H.T.O. (T 180-72)
Permeability Per, "Falling Head Permeability Test" by K.H. Head in,
"Manual of Soil Laboratory Testing, Volume 2. November 1981"

LABORATORY TEST RESULTSProctor Moisture Density Relationship

Test #1 114.6 PLF
Test #2 116.0 PLF

Respectfully submitted,

William R. Underwood
William R. Underwood, P.E.

NLI 001 0371

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike

Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, P. E.


Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Company
 PROJECT: N.L. Industries
 REQUIREMENT: Fill Cover Analysis, Woolwich Sand & Gravel
 DATE: July 26, 1983
 UF&S REF. NO. 4580

LABORATORY ANALYSISSIEVE ANALYSIS

SIEVE SIZE	PERCENT PASSING		
	#1 Sand SAMPLE	#2 Gravel SAMPLE	#3 Top Soil SAMPLE
3/4"	100	90.0	100
1"	100	100	100
#4	100	62.0	99.3
#16	97.8	49.3	92.7
#50	29.6	9.7	42.6
#100	9.3	3.0	25.0
#200	2.9	1.2	10.0
Permeability	2.5×10^{-2}	7.5×10^{-2}	1.8×10^{-2}

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.



William R. Underwood, P.E.
 CC to Mr. M. Corbin, Weston Way
 West Chester, Pa.

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike
Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, M

Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Co.
PROJECT: N.L. Industries, Pedricktown, N. J.
INSPECTION REQUIRED: Topsoil & Planting Cover
DATE: Sept. 21, 1983
UF&S REF. NO.: 4669-A

REPORT

Purpose

The purpose of this report is to address the planting and maintenance of the final cover of the solid waste landfill at the above location.

Planting

The tops and slopes of the above landfill were planted with mixture of fertilizer and seeds as follows:

The slopes were planted with 100 pounds of annual rye and 25 pounds of crown vetch per acre.

The top was planted with 50 pounds of perennial rye, 30 pounds of K-31 and 30 pounds of chewing fescue per acre.

Fertilizing

The entire cover was fertilized with 300 pounds of 10-20-10 fertilizer per acre and one thousand pounds of lime per acre.

Maintenance

After initial successful growth of the above, fertilizer, as required may be added during March of 1984.

No cuttings of the above plantings should be performed.

Any erosion of the slopes should be repaired as soon as possible.

Qualifications

The above information is per Lewis Colameco of Lewis Colameco & Sons of Pennsylvania (215-647-4977). Any inquiries should be directed to him.

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.


William R. Underwood, P.E.

NLI 001 0373

inter-office memorandum

TO: M. Corbin

DATE: 18 November 19

FROM:


R. Buss

SUBJECT: N. L. INDUSTRIES

W. O. No.: 0793-08-04

Pedricktown, N.J. Landfill Facility
Secondary Liner Leak Detection System Monitoring
Sumps A & B

Steve Holt and I established a liquid level monitoring procedure and obtained the initial (certified) "sounding" measurements to liquid levels in secondary sumps A & B today. (See sketch and table of measurements included herein).

After reviewing and testing several methods, we established the following procedure for obtaining measurements to accurately monitor the liquid levels in the secondary sumps.

Procedure as follows:

1. Confirm that the 1½" PVC suction line (retained in place for secondary sump pumping) is laying on the invert of the 10" C.M.P.
2. Insert the 1/2" copper (collapsible) "sounding" rod into the 1½" PVC line as far as the wire stop at the end of the 1½" PVC line.
3. Using chalk (or other temporary marking material) carefully mark the 1/2" copper "sounding" rod at a point coinciding with the end of the 10" C.M.P.
4. Withdraw the copper "sounding" rod and measure the dimension along the rod from the point marked as described in 3 above, to the *beginning of the wetted area of the rod.

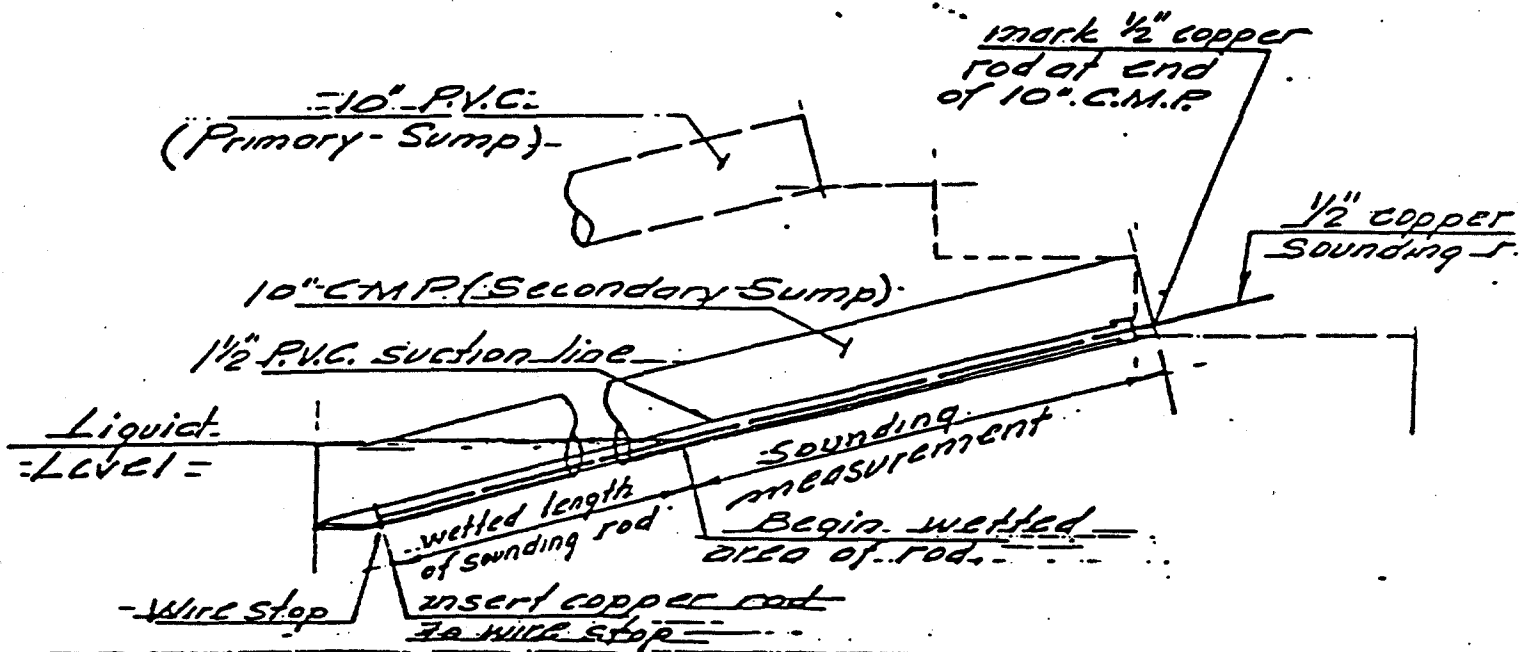
* The measurement described in 4 above must be taken promptly (particularly in dry/windy conditions) due to evaporation of moisture from the rod surface. To maximize clarity of the beginning of the wetted area, the surface of the "sounding" rod should be "chalked" in the approximate area of anticipated liquid level prior to insertion.

NLI 001 0374

18 November 1983

The following table is a record of the initial "sounding" measurements obtained at secondary sumps A & B today in accordance with the procedure described above:

<u>Sump</u>	<u>Sounding Measurement</u>	<u>Date</u>	<u>Time</u>
A	28.26'	November 18, 1983	1:30 p.m.
B	29.90'	November 18, 1983	1:45 p.m.



SKETCH SHOWING DETAILS OF SECONDARY SUMP SOUNDINGS

The procedure described above is relatively simple and will insure maximum consistency in monitoring the liquid levels.

It is my understanding that the secondary sumps will be monitored regularly, every Monday A.M., prior to commencement of leachate pumping from the primary sumps for that week.

If you have any questions or need additional information, don't hesitate to call.

Dick

N

RECEIVED

FEB 23 1984

ENVIRONMENTAL
CONTROL

February 16, 1984

Mr. Frank Coolick, Chief
Bureau of Hazardous Waste Engineering
Division of Waste Management
N.J. Department of Environmental Protection
32 E. Hanover St.
Trenton, N.J. 08625

Dear Mr. Coolick:

Your letter of January 23rd refers to the observance of localized cover soil erosion and loss of vegetative cover, and minor wash outs of slopes during a field inspection of the referenced landfill on December 7, 1983 to support a determination that closure is "deemed" incomplete.

The field inspection of December 7 is not relevant to the issue of closure as it was carried out more than two months following the completion of closure of the landfill which took place during the week of September 19, 1983. Closure of the landfill was completed on the verbal authorization of the Department since the time needed by the Department to formally issue its written approval of NL's closure and post closure plans would have delayed closure for an additional year. The formal written approval was issued by the Department on October 20, 1983, a month after closure had been completed in accordance with the Department's verbal authorization.

The localized erosion and loss of vegetative cover was caused by heavy rainfall after the completion of closure. Prior to these rains, vegetative cover had been established over the entire landfill surface. Furthermore, while vegetative cover is necessary for the long term protection of the clay cap, it is the clay cap itself which seals the landfill; there are no indications that the clay cap has been damaged.

The closure and post closure plans approved by the Department contemplated localized erosion and loss of vegetative cover such as that which has been experienced at the landfill for a number of years, until vegetation is "firmly established". The post closure plan dated December 15, 1982, states:

NL Industries, Inc.
1230 Avenue of the Americas, New York, N.Y. 10020

NLI 001 0376

"Until the vegetative cover is firmly established it may be expected that some erosion could take place. Soil will be replaced in these areas and they will be reseeded as necessary".

An effort was made in the fall to repair the eroded area as provided for in the post closure plan. However, due to the onset of winter, vegetation was not reestablished. We assure you that additional repairs, reseeded and revegetation of the eroded areas will be performed in the Spring.

Roy F. Weston, Inc. is writing to you under separate cover to clarify its closure certification of December 13, 1983, as to the time of completion of closure of the landfill and the presence of vegetative cover on all side slopes.

In light of the foregoing, NL requests that the Bureau reconsider its position and confirm the Department's determination that closure of the landfill was completed in September, 1983.

With respect to the three enumerated items set forth in your letter please be advised:

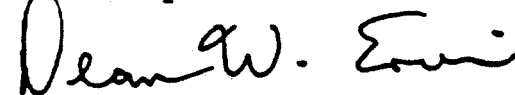
1. NL will request the surveyor to indicate headwalls, sumps and wells as you have requested. The clay core sampling locations were not surveyed, but they are described in Weston's December 13, 1983 letter to Mr. Londres and are shown in the attached sketch by Mr. Underwood (a professional engineer) of Underwood, Furman & Snyder Testing Laboratories, the laboratory which collected the samples.
2. Attachment 2 of Weston's December 13, 1983 letter presents the permeability results of the top soil and gravel samples performed by Underwood, Furman & Snyder Testing Laboratories. The use of gravelly sand for the flow zone was included in Weston's August 11, 1983 letter supplementing the closure plan which NL submitted to the Department on August 16, 1983. The results confirming permeability of material denoted as gravel in the Underwood test report refer to this gravelly sand.
3. The measurement referred to in certification 7 was intended to provide a reliable reference point for future

measurements (not a comparison with other measurements previously taken) pursuant to an agreement reached with the Department on October 27, 1983. Accordingly, the results of the two procedures are not directly comparable. However, the following comparison can be made using the liquid levels measured in the secondary sumps on November 14 and November 21, 1983 in view of the consistent measurements previously obtained.

<u>Date</u>	<u>Phase A Secondary Sump</u>	<u>Phase B Secondary Sump</u>	<u>Comments</u>
11/14/83	1.75	3.75	Wetted length of riser pipe
11/21/83	28.3	29.9	Dry length of riser pipe
	<hr/>	<hr/>	
	30.05	33.65	Total length of riser pipe

Therefore, the approximate corresponding depths to water (dry length of riser pipe) for previous measurements may be obtained by subtracting the wetted length of the sounding rod from the total length of the riser pipe. A copy of Attachment 4 to Weston's December 13 Certification of Landfill Closure, describing the procedure is enclosed for your convenience.

Sincerely



Dean W. Ervin
Director Metals Operations

DWE/gs
Enclosures
c: Paul Kahn, Esq. - w/encls.

bc: W. Bronner
J. Jacobs
R. Losey
W. Weddendorf ✓



WESTON WAY
WEST CHESTER, PA. 19380
PHONE: (215) 692-3030
TELEX: 83-5348

RECEIVED

FEB 21 1984

ENVIRONMENTAL
CONTROL

16 February 1984

Mr. Edward J. Londres
Assistant Director - Engineering
Division of Waste Management
N.J. Department of Environmental Protection
32 E. Hanover Street CN027
Trenton, NJ 08625

Reference: Landfill Closure Certification
N.L. Industries, Inc.
Pedricktown, New Jersey
Facility No. 1706C
EPA I.D. #NJ061843249

Dear Mr. Londres:

In response to the question of certification relating to final vegetative cover for the referenced facility, the following clarification to our closure certification of December 13, 1983, is provided. The certifications set-forth in our December 13 letter with the exception of the last sentence in certification paragraph #7 and certification paragraph #9 were made as of September 30, 1983, when closure of the landfill was completed.

After seeding of the final cover during the week of September 12, 1983, vegetative cover was established on all slopes. After vegetative cover was established, several heavy rain storms occurred at the site. These storms caused some localized erosion on the landfill slopes. Steps were undertaken to repair the localized erosion using maintenance procedures as set forth in the post closure plan. The last sentence in our certification paragraph #7 notes that localized erosion was observed on November 18, 1983, at the time of the sump measurements subsequent to landfill closure.

WESTON

TO: Mr. Edward J. Londres -2-
N.J. Dept. of Environmental Protection

16 February 1984

Sump sounding measurements detailed in our certification paragraph #9 were taken on November 18, 1983, pursuant to our October 27, 1983, meeting with NJDEP. This sounding certification provides the basis for future monitoring of liquid levels in these sumps under the post closure plan.

If I can provide further information on this matter, please contact me.

Sincerely,

ROY F. WESTON, INC.



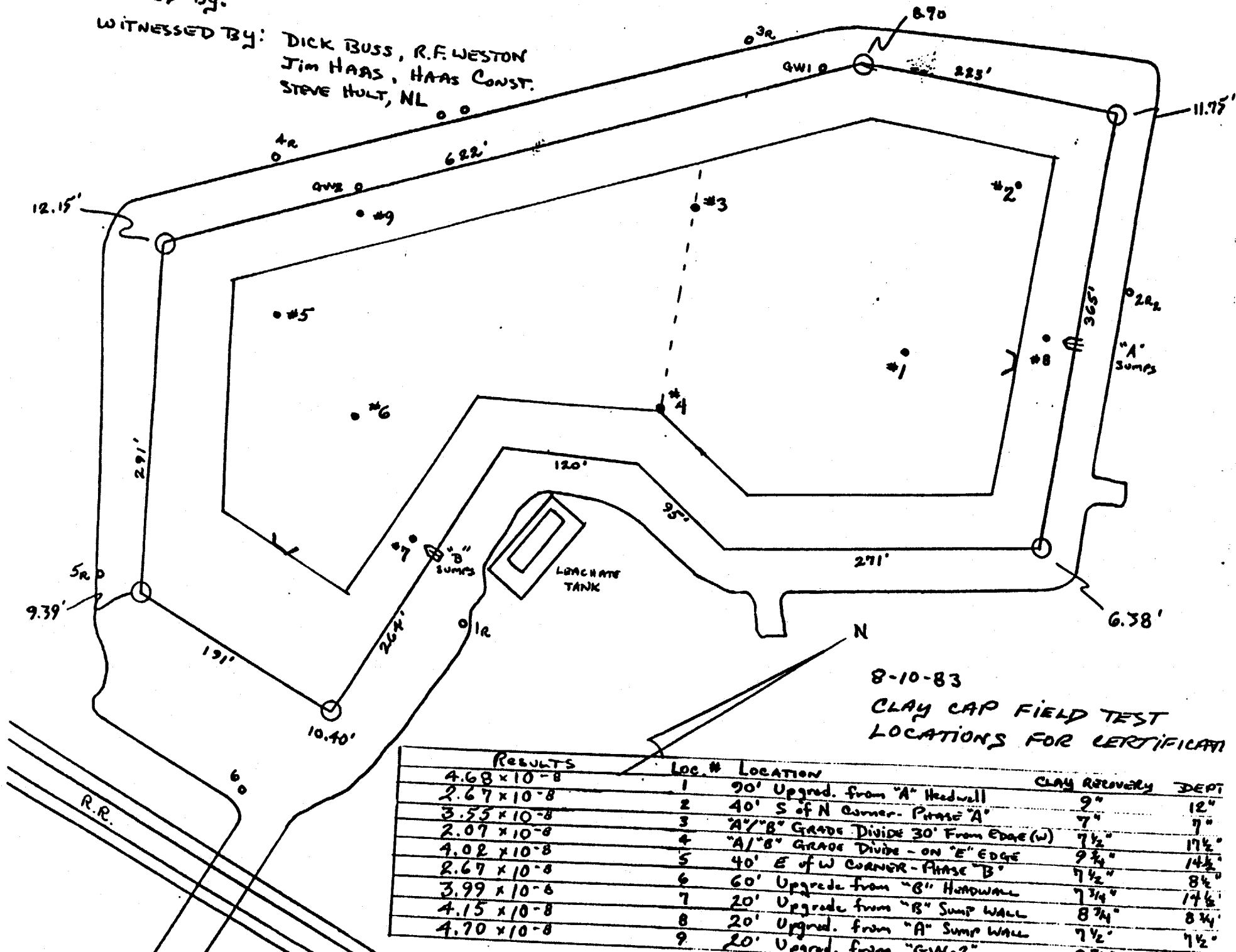
Michael H. Corbin
Project Manager

MHC:jac

cc: Dean Ervin - NL Industries
Jeffrey Jacobs - NL Industries
William Weddendorf - NL Industries
James Dougherty - WESTON

TESTED BY:

WITNESSED BY: DICK BUSS, R.F. WESTON
JIM HAAS, HAAS CONST.
STEVE HOLT, NL



RESULTS	LOC. #	LOCATION	CLAY RECOVERY	DEPT
4.68×10^{-8}	1	20' Upgrad. from "A" Headwall	9"	12"
2.67×10^{-8}	2	40' S of N corner - Phase "A"	7"	7"
3.55×10^{-8}	3	"A"/"B" Grade Divide 30' From Edge (W)	7 1/2"	17 1/2"
2.07×10^{-8}	4	"A"/"B" Grade Divide - on "E" Edge	9 1/4"	14 1/2"
4.02×10^{-8}	5	40' E of W corner - Phase "B"	7 1/2"	8 1/2"
2.67×10^{-8}	6	60' Upgrade from "B" Headwall	7 3/4"	17 1/2"
3.99×10^{-8}	7	20' Upgrade from "B" Sump Wall	8 3/4"	8 3/4"
4.15×10^{-8}	8	20' Upgrade from "A" Sump Wall	7 1/2"	7 1/2"
4.70×10^{-8}	9	20' Upgrade from "G.W. 2"		

UNDERWOOD, FURMAN & SNYDER TESTING LABORATORIES, INC.

3 South Black Horse Pike
Mt. Ephraim, N. J. 08059

William R. Underwood, P. E.

William M. Furman, Manager

 Soil Borings - Soil Engineering - Testing - Inspection - Concrete - Steel - Asphalt - Masonry

CLIENT: Haas Construction Company
 PROJECT: N.L. Industries
 TEST/INSPECTION REQUIRED: Clay Cover Laboratory Tests
 LOCATION: N.L. Industries, Pedricktown, New Jersey
 DATE: Sampled-8/10/83
 UF&S REF. NO.: 4617

TEST/INSPECTION RESULTS

All tests and inspections performed on the above landfill were satisfactory and met or exceeded project qualifications.

Below are the results of the most recent tests.

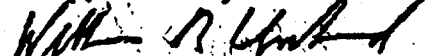
Sample #	Permeability (cm/sec)	Depth of Clay (")	Location
1	4.68×10^{-8}	12.0"	90' Upgradient apron fr. A Headwall
2	2.67×10^{-8}	7.0"	40' S. of N. corner Phase A
3	3.55×10^{-8}	17½"	Center gradient edge slope div. 30' fr
4	2.07×10^{-8}	14½"	Gradient Div. on E. edge of side slop
5	4.02×10^{-8}	8½"	40' E. of W. corner Phase B
6	2.61×10^{-8}	14½"	60' Upgradient fr. B Headwall
7	3.99×10^{-8}	8 3/4"	20' Upgradient fr. B sump wall
8	4.15×10^{-8}	7½"	20' Upgradient fr. A. sump wall
9	4.70×10^{-8}	19 3/4"	20' Upgradient fr. B. gas monitoring Wall #2

Proctor Per AA.- S.H.T.O. (T 180-72)
 Permeability Per, "Falling Head Permeability Test" by K.H. Head in,
 "Manual of Soil Laboratory Testing, Volume 2. November 1981"

LABORATORY TEST RESULTSProctor Moisture Density Relationship

Test #1 114.6 PLF
 Test #2 116.0 PLF

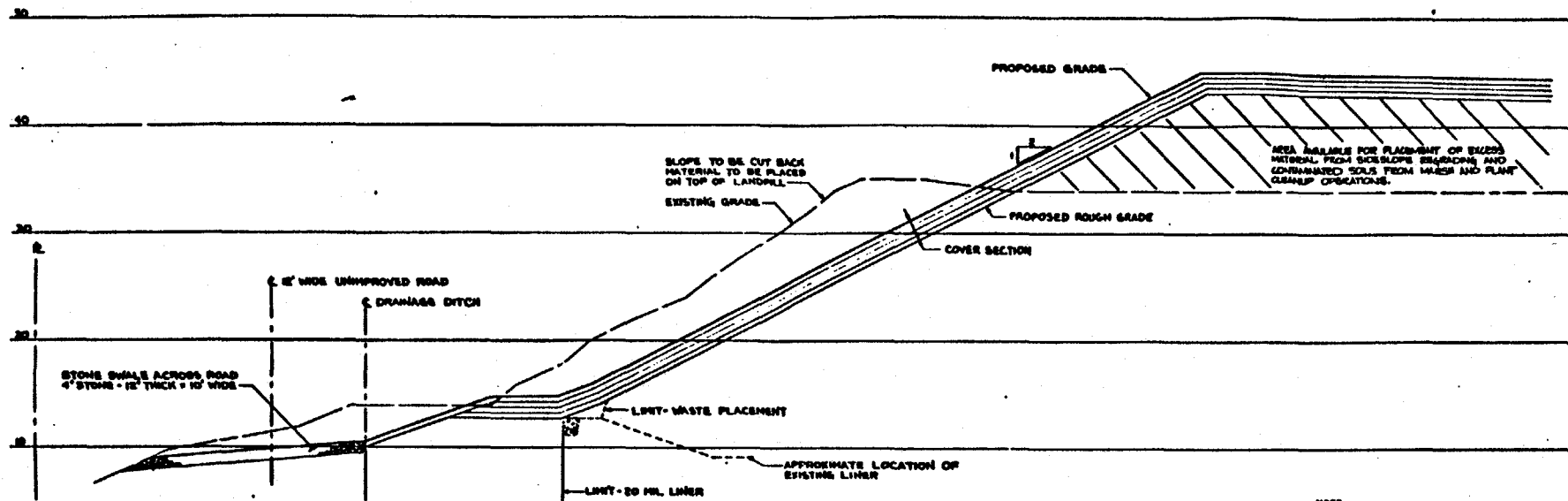
Respectfully submitted,


 William R. Underwood, P.E.

NLI 001 0382



①

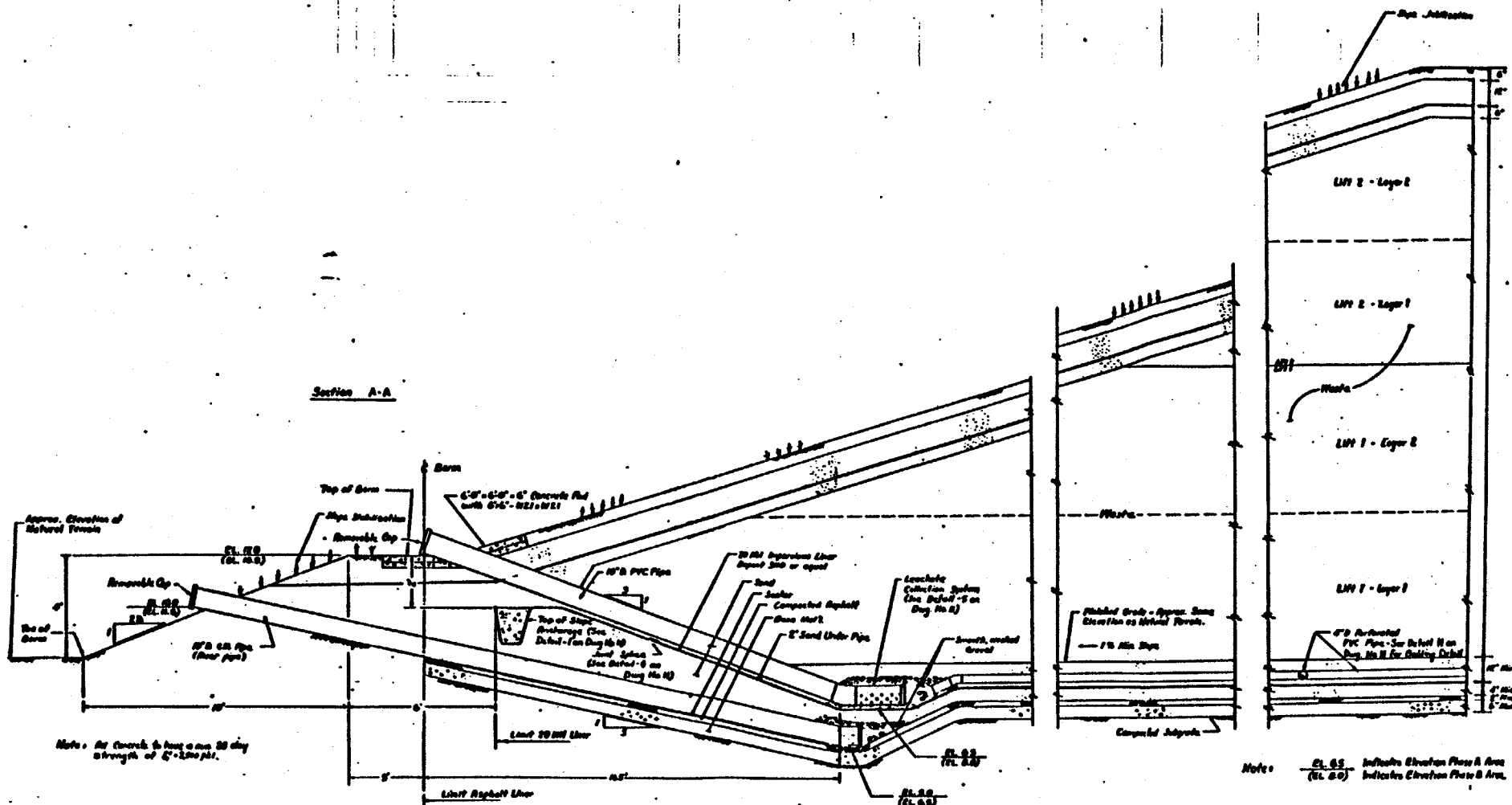


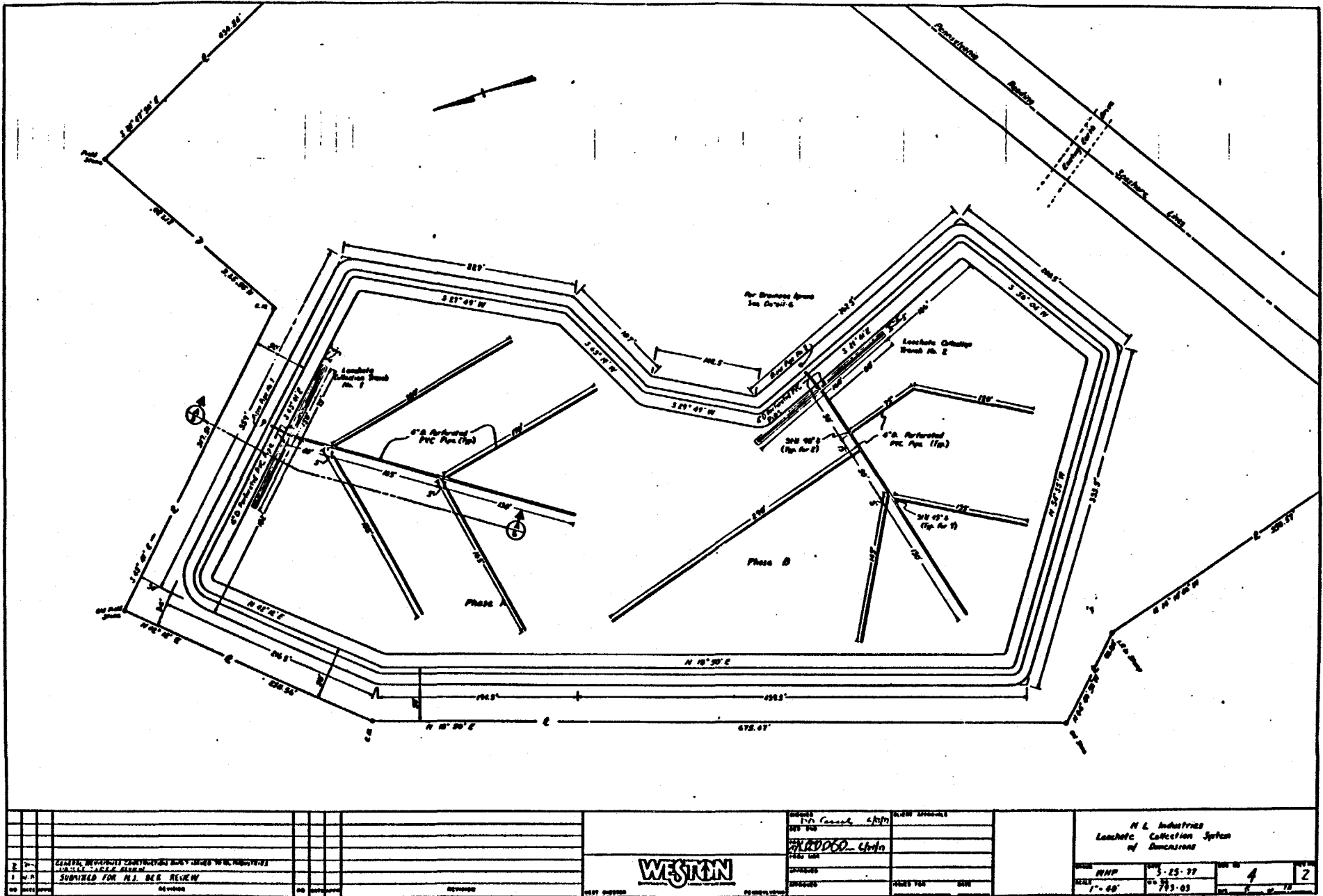
NOTE:

1. REFER TO DWG. 500 FOR PLAN
2. SEE DWG. 500 FOR COVER DETAIL

NLI 001 0384

				NLI METAL / NLI INDUSTRIES, INC. PEDRICKTOWN PLANT SALEM COUNTY NEW JERSEY				SECTION A-A			
				WESTON				L. FARMAS			
				DATE: 8-19-01				7			
				SCALE: 1" = 5'				1			





WESTON

DESIGNED BY
 DRAWN BY
 CHECKED BY
 DATE
 PROJECT NO.
 SHEET NO.

H. L. Industries
 Leachite Collection System
 of Dimensions

DATE: 3-25-77
 SCALE: 1" = 40'
 SHEET: 4 OF 2

Existing Grades
Finished Lower Movement Grades
Location of Bottom Flats
Lower Anchor.
Approximate Location of Existing
Monitoring wells
Approximate Location of Monitoring
Wells of Substation is necessary

Note: (1) Verbal Contract Interview
(2) Written Question: shown are finished lower Placement Grades - Initial Placement shall be - 1st Below three Grades, or to complete removal of all existing and filled slots, whichever is greater.
(3) Refer to Drawings No 2A + 2B for Existing Grades.

[illegible]

EXHIBIT B
MONITORING WELL LOGS

LEGGETTE, BRASHEARS & GRAHAM, INC.

72 - DANBURY ROAD

WILTON. CT. 06897

PAGE -1 OF 1 PAGES

NLI 001 0389

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

-72 DANBURY ROAD

WILTON, CT. 06897

PAGE 1 OF 1 PAGES

NLI 001 0390

A.C. SCHULTES & SONS, INC.

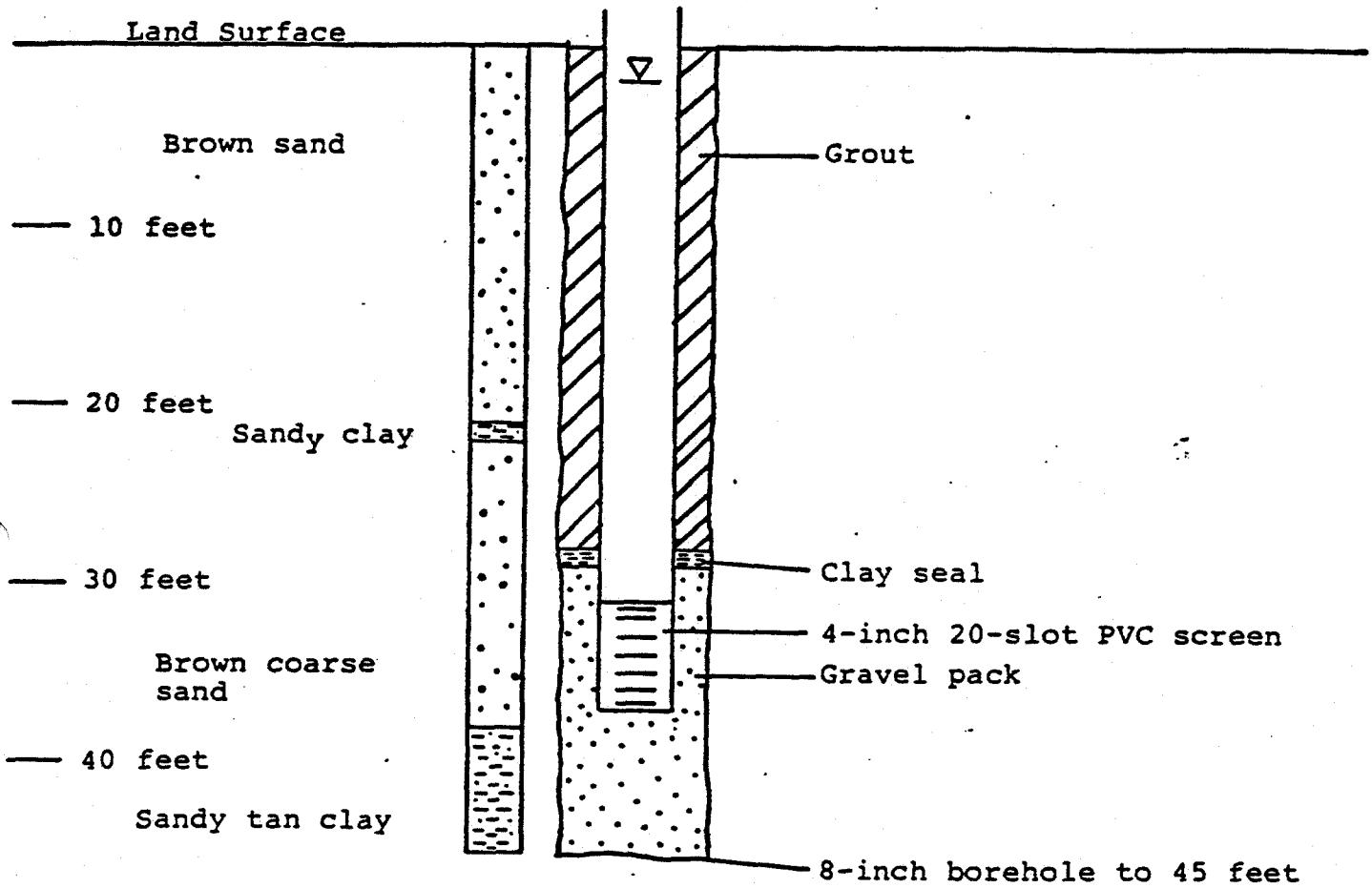
SINGLE CASE WELL

GROUND		2' LEVEL	WELL LOG	FEET FROM GROUND SURFACE 0 TO 1	NAME OF OWNER
37' 0" TOTAL DEPTH - FT.			Top Soil		National Lead
			Brown Sand-Coarse to Medium Clay	1 - 26	Job # 18411
			Clay	26 - 27	Location Pedricktown, N
			Coarse Brown Sand	27 - 38	Well No. B-R
			Clayish	38 - 45	Mrs. Pumped Air Devel. 2
					Capacity G.P.M. 30
					Static Level 4'
					Pumping Level --
					Specific Capacity --
					Diameter of Well 4"
					Depth of Well (ground) 37' 0"
					Length of Casing 33'
					Distance to Top of Packer (gr.) --
			CASING		Type Screen PVC
					Size of Screen 4"
					Length of Screen 6' 0"
					Top Screen Fitting PVC Socket
					Bottom Screen Fitting Cap
					Blank --
					Slot Size .018
			Drilling Machine No. 6B		
			Driller C. Sacco		
			Gravel #1		
			Bags of Cement 10		
			Date Well Completed 1/1/80		

Rotary Table approx. 3' above ground level

NLI 001 0391

N/L INDUSTRIES, INC.
Pedricktown, New Jersey
Completion Diagram for Well BR



Well completed April 1 1980

▽ SWL = 1.9 feet below grade, April 3 1980

Leggette, Brashears & Graham, Inc.

April 1980

WILTON, CT. -06897

PAGE 1 OF 1 PAGES

NLI 001 0393

A.C. SCHULTES & SONS, INC.

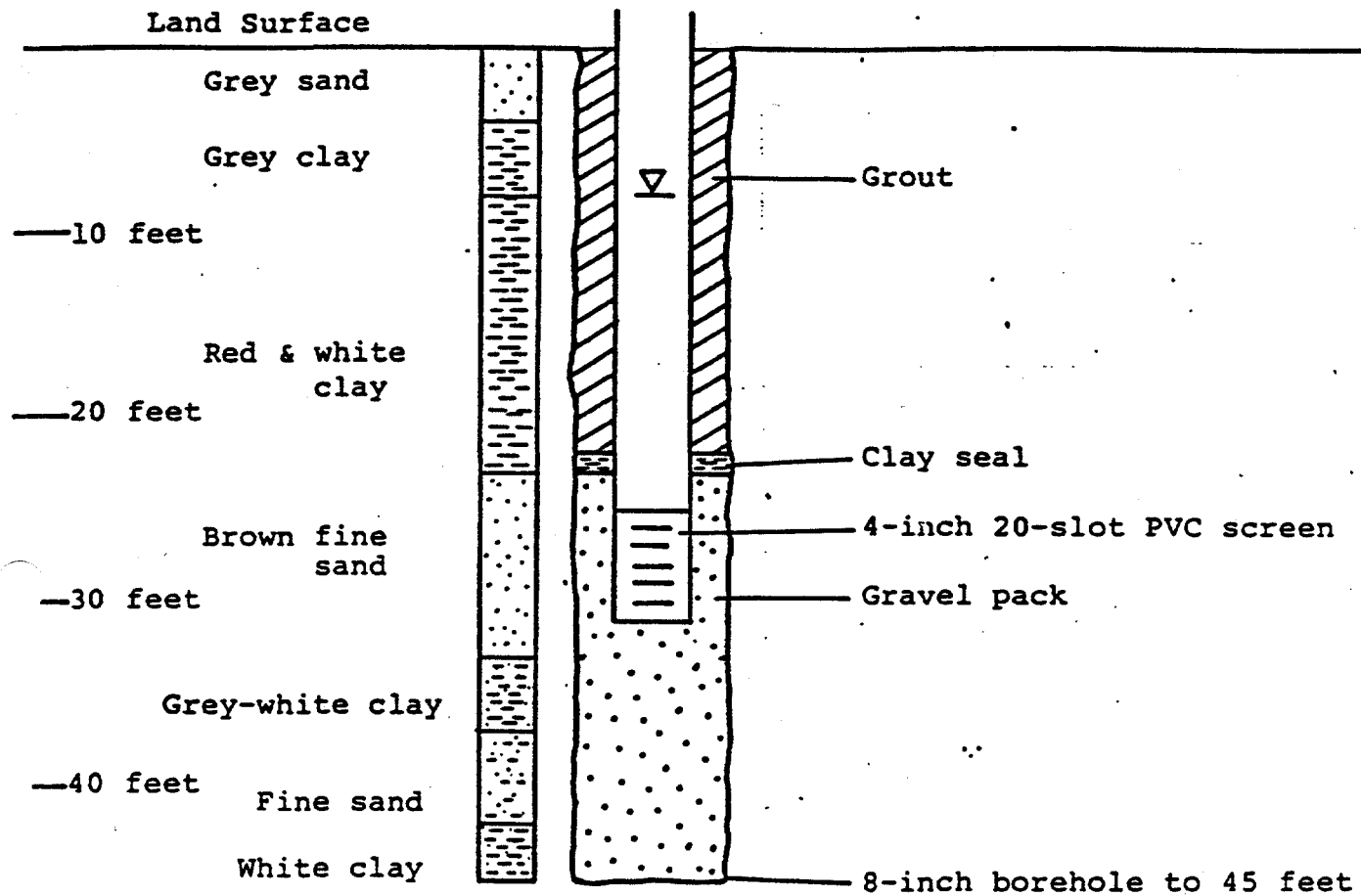
SINGLE CASE WELL

GROUND		2" LEVEL	WELL LOG	FEET FROM GROUND SURFACE	NAME OF OWNER
31' TOTAL DEPTH - FT.	<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">6" STRAINER</div> <div style="border: 1px solid black; width: 20px; height: 100px; margin-left: 5px;"></div> </div>	<div style="display: flex; align-items: center;"> <div style="width: 20px; height: 20px; border: 1px solid black; margin-right: 5px;"></div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">CASING</div> </div>	Gray Sand-Med. to Fine	0 TO 4	National Lead
			Gray Clay	4 - 8	Job = 18411
			Red & White Clay	8 - 23	Location Pedricktown,
			Fine Brown Sand	23 - 33	Well No. C2R
			White Clay	33 - 37	Mrs. Pumped Air Devel. 3
			Fine Brown Sand	37 - 42	Capacity G.P.M. 20
			White Clay	42 - 45	Static Level --
					Pumping Level --
					Specific Capacity --
					Diameter of Well 4"
					Depth of Well (ground) 31'0"
					Length of Casing 27'0"
					Distance to Top of Packer (gr.) --
					Type Screen PVC
					Size of Screen 4"
					Length of Screen 6'0"
					Top Screen Fitting PVC Socke
					Bottom Screen Fitting Cap
					Blank --
					Slot Size .018
		Drilling Machine No. 6B			
		Driller C. Sacco			
		Gravel #1			
		Bags of Cement 10			
		Date Well Completed 3/29/80			

Rotary Table approx. 3' above ground level

NLI 001 0394

N/L INDUSTRIES, INC.
 Pedricktown, New Jersey
 Completion Diagram for Well CR2



Well completed March 29 1980

▽ SWL = 7.9 feet below grade, April 3 1980

Leggette, Brashears & Graham, Inc.

April 1980

PAGE 1 OF 1 PAGES

NLI 001 0396

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

72 DANBURY ROAD

WILTON, CT. 06897

PAGE 1 OF 1 PAGES

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER
Sand, brown, fine to medium, some coarse	7	7	NL Industries, Inc.
Sand, fine to medium, with much coarse to very coarse sand and some fine gravel	11	18	LOCATION: Pedricktown, NJ
Gravel, brown, fine, subrounded, some medium gravel and fine to very coarse sand	3	21	WELL No.: 2R2
Clay, red and white, silty	4	25	DATE COMPLETED: October 15, 1980
			DRILLING COMPANY: A. C. Schultes & Sons, Inc.
			DRILLING METHOD: water rotary
			SAMPLING METHOD: ditch
			SAMPLES EXAMINED BY: Sandy Strausberg
			REFERENCE POINT: Land surface
			ELEVATION OF R. P.: ± 7.2 feet MSL
			CASING:
			SCREEN TYPE: PVC
			DIAM.: 4-inch SLOT No. 20
			SETTING: 13-20 feet
			PUMPING TEST DATE: October 16, 1980
			DURATION: 4 hours
			STATIC WATER LEVEL: 5.52 feet below grade
			PUMPING WATER LEVEL: 7.79 feet below grade
			YIELD: 6 gpm
			REMARKS:
			Hole to 25 feet
			Gravel pack (Morie #1) 7-25 feet
			Bentonite 7 feet to surface
			Casing ID = 4 inches

NLI 001 0397

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

72 DANBURY ROAD

WILTON, CT. 06897

PAGE 1 OF 1 PAGE

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: N/L Industries, Inc
Sand, fine, light brown, silty	3	3	LOCATION: Pedricktown, NJ
Sand, fine to medium, light brown, silty	4	7	WELL NO. 3 (Replacement)*
Sand, fine to medium, with some fine gravel and silt	4½	11½	DATE COMPLETED: December 17, 1979
Sand, fine to medium, light brown, with some fine to medium gravel	4	15½	DILLING COMPANY: Craig Testing Labs
Sand, fine to medium, brown, with white clay lenses	5	20½	DILLING METHOD: Mud rotary (benton)
Clay, tan, fine sandy	2½	23	SAMPLING METHOD: Ditch
Sand, fine to medium, brown, with gra- vel, fine and little silt and clay	4	27	SAMPLES EXAMINED BY: Lee Grubman
Sand, medium to coarse, tan, some fine gravel	1	28	REFERENCE POINT: Land surface
Sand, medium to coarse, reddish-tan, some fine gravel, with white clay lenses	2½	31½	ELEVATION OF R. P.:
Clay, red-brown, with sandy lenses	1½	33	CASING:
(A sample of red clay was taken from the drill bit)			SCREEN- TYPE: Slotted PVC
			DIA.: 4 inch SLOT NO. 20
			SETTING: 4-33 feet
			PUMPING TEST: DATE:
			DURATION:
			STATIC WATER ±4 feet after drill
			PUMPING WATER LEVEL:
			YIELD: ±4 gpm during devel ment
			REMARKS: * Located ±15 feet sout west of original well

NLI 001 0398

WILTON, CT. 06897

PAGE _____ OF _____ PAGES

NLI 001 0399

72 DANBURY ROAD
WILTON, CT. 06897

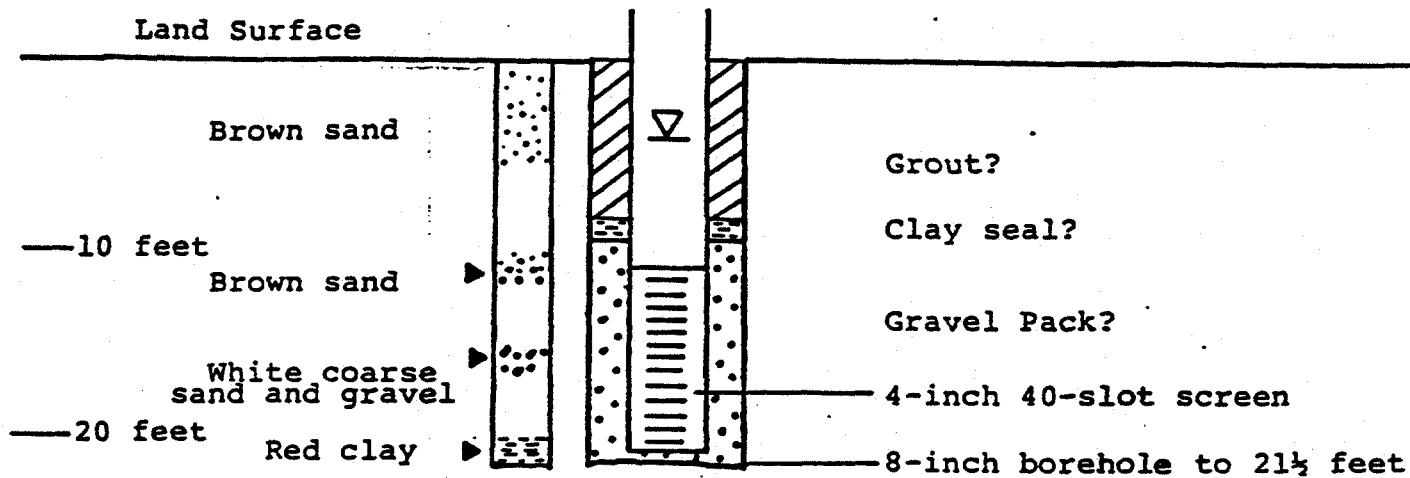
PAGE _____ OF _____ PAGES

NLI 001 0400

LEGGETTE, BRASHEARS & GRAHAM
CONSULTING GROUND-WATER GEOLOGISTS
55 WEST STATE STREET
WESTPORT, CONNECTICUT

[illegible]

N/L INDUSTRIES, INC.
 Pedricktown, New Jersey
 Completion Diagram for Well 6



► Split spoon sample

Well completed October 8 1976

▽ SWL = 4.2 feet below grade, April 3 1980

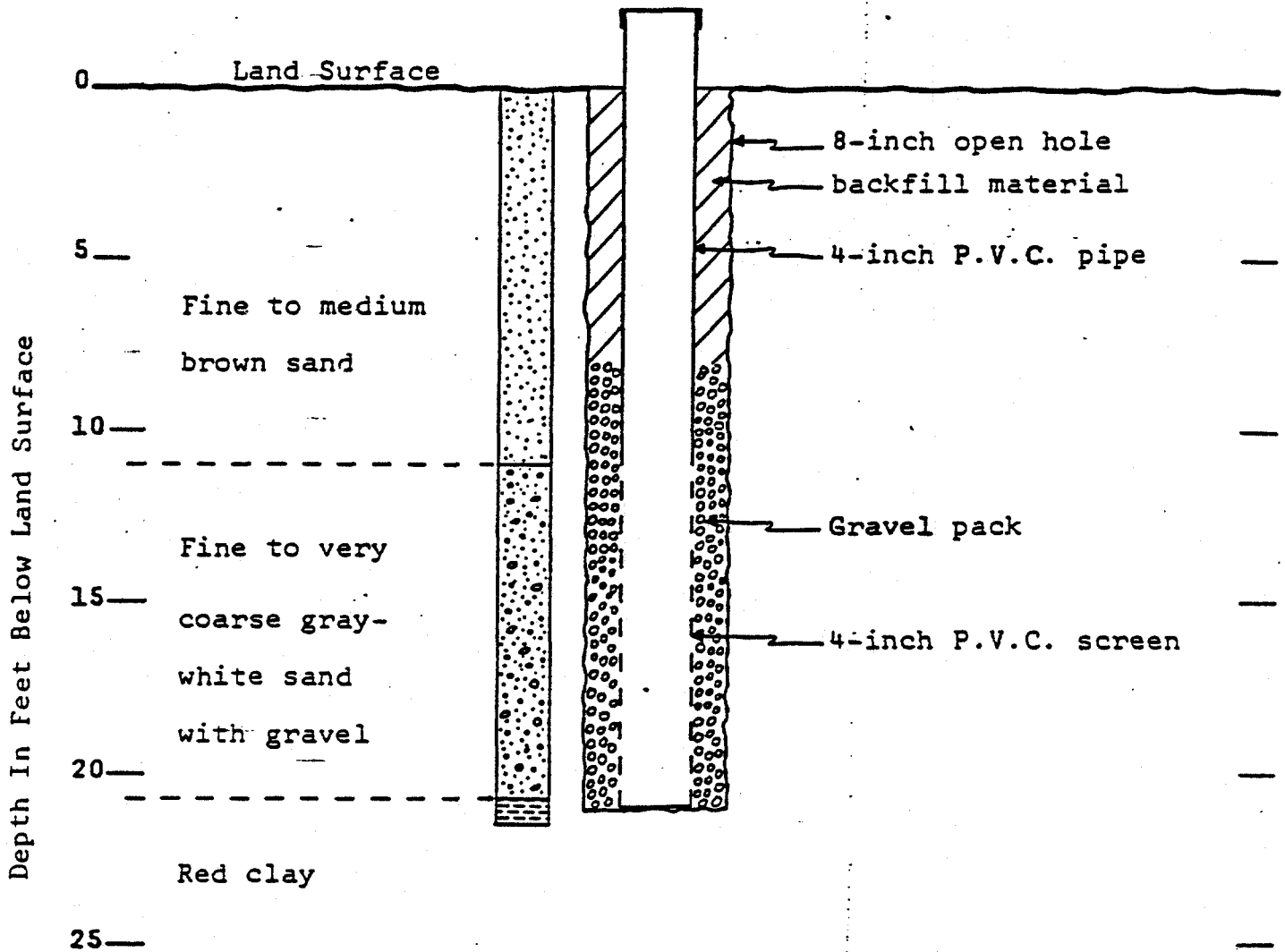
Leggette, Brashears & Graham, Inc.

April 1980

NLI 001 0402

N.L. INDUSTRIES
Pedricktown, New Jersey

Completion Diagram for Observation Well 6.



Leggette, Brashears & Graham, Inc.
October, 1976

NLI 001 0403

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

72 DANBURY ROAD

WILTON, CT. 06897

PAGE 1 OF 3 PAGES

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	Interval of core of core recovery drive	OWNER: NL Industries, Inc.
To save time the driller was instructed				LOCATION: Pedricktown, NJ
to begin split spoon sampling at 10				WELL NO.: 8R (Replacement)
feet below grade. Upper materials				DATE COMPLETED: March 19, 1980
based on landfill cut are brown sand,				DRILLING COMPANY: A. C. Schultes & Son
plastic fill, and some clay lenses		0-10		DRILLING METHOD: Mud Rotary
Sand, fine to medium, brown	.5	10-11.5		SAMPLING METHOD: Split spoon
Sand, medium, some fine, red and				SAMPLES EXAMINED BY: R. Lamonica
brown; trace clay	.5	15-16.5		REFERENCE POINT: Grade
Sand, very fine to coarse, brown;				ELEVATION OF R. P.:
trace clay	.5			CASING: 4-inch PVC Plastic
Sand, very coarse, and clay, white	.2	20-21.5		SCREEN TYPE: Slotted PVC Plastic
Sand, fine, white	.8	25-26.5		DIAM.: 4-inch SLOT NO.: 020 in
Sand, fine-medium, brown	.6			SETTING: 101-108 feet
Sand, fine-medium, white, with streaks				PUMPING TEST DATE:
of clay, white; few $\frac{1}{4}$ inch gravel	.25	30-31.5		DURATION:
Driller reported formation change to				STATIC WATER LEVEL: 20.35 feet below
clay		32		PUMPING WATER LEVEL:
Clay, gray, some yellow streaks, very				YIELD: 1 gpm
stiff	1.0	35-36.5		REMARKS:
Clay, predominantly red and brown,				
some gray, mixed with sand, coarse	1.0	40-41.5		
Sand, fine, clayey, light gray, yellow				
streaks	1.0	45-46.5		
Clay, with fine sand, light gray,				
yellow streaks	1.0	50-51.5		
(Continued)				

NLI 001 0404

WELL LOG

LEGGETTE, BRASHEARS & GRAHAM, INC.

CONSULTING GROUND-WATER GEOLOGISTS

72 DANBURY ROAD

WILTON, C.T. 06897

PAGE 2 OF 3 PAGES

DESCRIPTION	THICK- NESS (FEET)	DEPTH (FEET)	OWNER: NL Industries, Inc.
Sand, fine, clayey, light gray	1.0	55-56.5	LOCATION: Pedricktown, NJ
Sand, fine to medium, light gray;			WELL No.: 8R (Replacement)
trace clay	.25	60-61.5	DATE COMPLETED:
Clay, plastic, white; trace sand,			DRILLING COMPANY:
medium	.10	64.5-66	DRILLING METHOD:
Clay, plastic, red, some white	1.0	66-67.5	SAMPLING METHOD:
Clay, stiff, red, some light gray	1.0	70-71.5	SAMPLES EXAMINED BY:
Clay, stiff, mottled red and light			REFERENCE POINT:
gray	1.5	75-76.5	ELEVATION OF R.P.:
Clay, stiff, mottled red and light			CASING:
gray	1.0	80-81.5	SCREEN TYPE:
Clay, stiff, mottled red and purple,			DIAM.: SLOT NO.
some light gray	1.0	84.5-86	SETTING:
Clay, very stiff, mottled, mostly			PUMPING TEST DATE:
light gray with red, purple and			DURATION:
yellow	1.0	90-91	STATIC WATER LEVEL:
Driller reported possible change of			PUMPING WATER LEVEL:
formation		92	YIELD:
Clay, very stiff, mottled, mostly			REMARKS:
light gray with red, purple and			
yellow	.2		
Sand, fine, clayey, bright yellow	.4	95-96	
Sand, fine to medium, light gray and			
yellow	.5	100-101	
SAMPLES FROM HERE ON ARE SHELBY TUBE			
Sand, fine to coarse, yellow, trace			

NLI 001 0405

LEGGETTE, BRASHEARS & GRAHAM, INC.

72-DANBURY ROAD

WILTON, CT. 06897

PAGE 3 OF 3 PAGES

NLI 001 0406

A.C. SCHULTES & SONS, INC.

GROUND	8" LEVEL	WELL LOG	FEET FROM GROUND SURFACE 0 TO 10	NAME OF OWNER
<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">108-0</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">TOTAL DEPTH - FT.</div> </div> <div style="display: flex; flex-direction: column; align-items: center; margin-top: 20px;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">7'0"</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">STRAINER</div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">4"</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">CASING</div> </div>	Brown Sand	0 TO 10	National Lead
		Brown & Red Med. Sand	10 - 16	Job # 18411
		Med. - Fine Sand and streaks of white clay	16 - 32	Location Pedricktown,
		Red & Gray Clay	32 - 56	Well No. 8R
		Fine to Med. Sand	56 - 67	Hrs. Pumped 8 hrs.
		Red & White Clay	67 - 86	Capacity G.P.M. 9 gal.
		Red, Yellow & Purple Clay	86 - 96	Static Level 18'
		Fine Sand & Some Sandstone	96 - 108	Pumping Level 93'
		Red & White Clay	108 - 116	Specific Capacity --
		Silty Gray Clay	116 - 122	Diameter of Well 4"
		Sand	122 - 124	Depth of Well (ground) 108-0
				Length of Casing 101-8
				Distance to Top of Packer (gr.) --
				Type Screen PVC
				Size of Screen 4"
		Length of Screen 7'0"		
		Top Screen Fitting PVC Socket		
		Bottom Screen Fitting Cap		
		Blank --		
		Slot Size .018		
		Drilling Machine No. 6B		
		Driller C. Sacco		
		Gravel #1		
		Bags of Cement 100		
		Date Well Completed 3/20/80		

Rotary Table approx. 3' above ground level

NLI 001 0406A

Land Surface

Brown sand

Brown-red medium sand

— 20 feet

Medium-fine sand,
streaks of white clay

Red & grey clay

— 40 feet

— 60 feet

Fine-medium sand

Red & white clay

— 80 feet

Red, yellow &
purple clay

— 100 feet

Fine sand with gravel

Red & white clay

— 120 feet Silty grey clay

Sand

N/L INDUSTRIES, INC.
Pedricktown, New Jersey

Completion Diagram for Well 8R

Grout

Well completed March 19 1980

▽ SWL = 18.1 feet below grade,
April 8 1980

Clay seal

Gravel pack

4-inch 20-slot PVC screen

Grout

12-inch borehole to 124 feet

► Split spoon sample

Loggelle, Brushbars & Graham, Inc.

April 1980

NLI 001 0407

LEGGETTE, BRASHEARS & GRAHAM, INC.

72 - DANBURY ROAD

WILTON, CT. 06897

PAGE 1 OF 1 PAGES

NLI 001 0408

A.C. SCHULTES & SONS, INC.

SINGLE CASE WELL

61' 0"
TOTAL DEPTH ± FT.

4"

8'0"

STRAINING

NAME OF OWNER

National Lead

Job # 18411

Location *Pedricktown, N*

Well No. 92R

Mrs. Pumped 8 hrs. +

Capacity G.P.M. 9

Static Level 16'

Pumping Level 45

Specific Capacity --

Diameter of Well 4"

Depth of Well (ground) 61' 0"

Length of Casing 55'

Distance to Top of Packer (gr.) --

Type Screen PVC

Size of Screen 4"

Length of Screen 8' 0"

Top Screen Fitting **PVC Sock**

Bottom Screen Fitting Cap

Blank

Slot Size .018

Drilling Machine No. 6B

Driller C. Sacco

Gravel #1

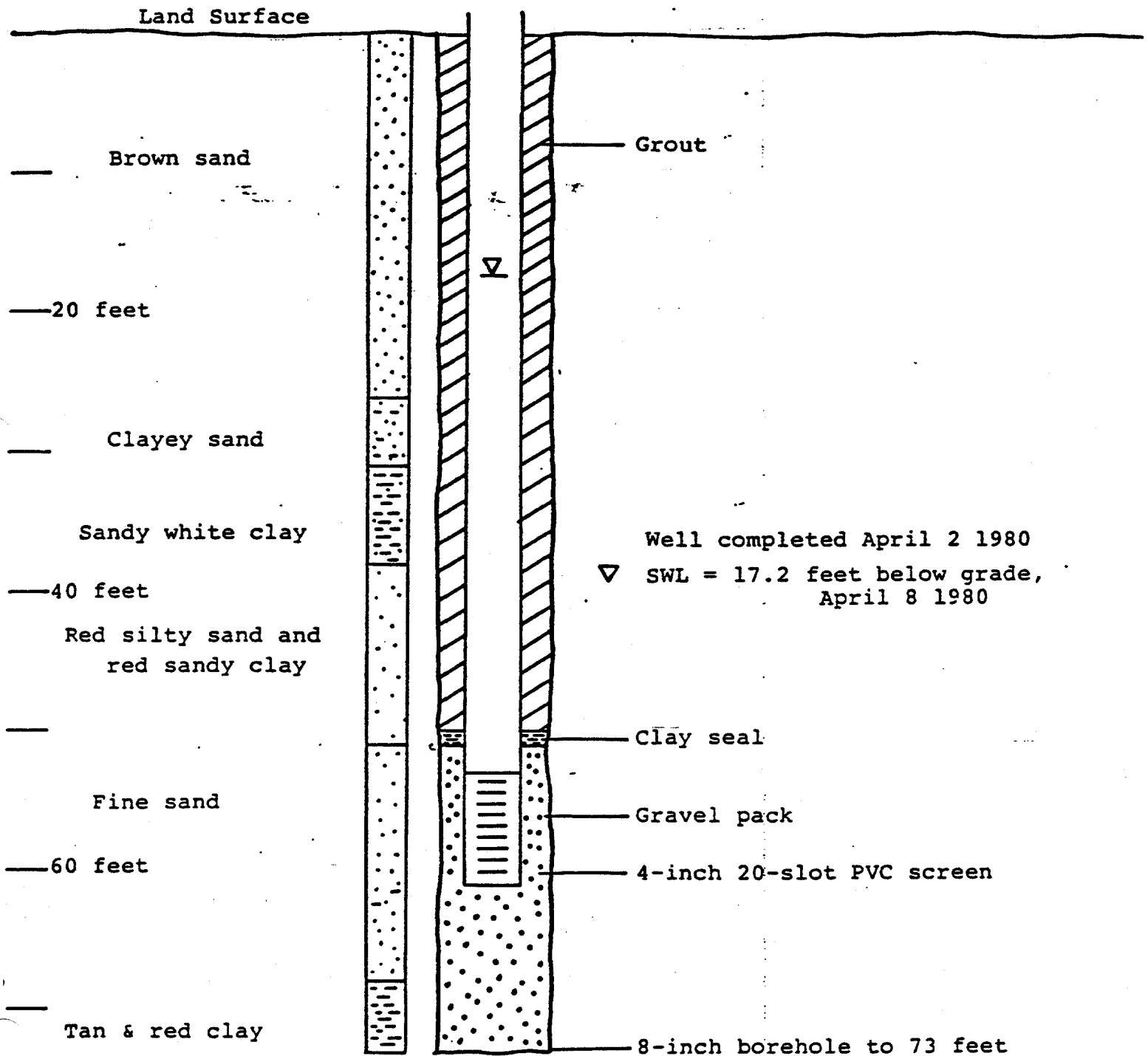
Bags of Cement 25

Date Well Completed 1/2/80

Retary Table approx. 3' above ground level

NLI 001 0409

N/L INDUSTRIES, INC.
 Pedricktown, New Jersey
 Completion Diagram for Well 9R2



Geologic Logs

Description	Depth (feet below land surface)	Thickness (feet)
Well 10		
Sand, brown, fine; with a trace of silt	0 - 4	4
Sand, gray, fine	4 - 14	10
Sand, gray, fine to coarse	14 - 20	6
Sand, gray-white, fine to coarse; with silt, clay and occasional lenses of clayey sand	20 - 28	8.0
Clay, red-pink, white, mottled; with silt	28 - 33	5
Silt, white; with some clay and very fine sand	33 - 41	8
Sand, gray-white, very fine; with silt and occasional lenses of silty clay	41 - 49	8
Sand, red-brown, fine to medium; with occasional gray-white lenses of sandy silt	49 - 63	14
Clay, red-pink, white, mottled; with silt	63 - 66	3
Sand, red-brown, fine to coarse	66 - 73.5	7.5
Clay, red, brown and white, mottled; with silt	73.5 - 79	5.5
Sand, red-brown, fine to medium; with lenses of silt, clay and gray sand	79 - 82	3

Date 10-14-83

MORETRENCH AMERICAN WELL REPORT

Contractor: _____

Job Address: A.L. - PERRICK TOWN WV

Job Phone: _____

Comments: _____

Branch No.: _____

No. of wells installed today: _____

Dia of borehole: 12"

Dia. of well: 4"

Type, dia., slot of screen .816

Travel Hours 2

Stand by Hours _____

Man Hours Regular: 8

Drill Hours Reg.: 8

Overtime: 4

O.T.: 4

Delays-Explain: WAITING FOR DEPTH

Delay Hours: 2

TO SET WELL

Rig No.: 0475

Job No.: 1-4235

Date: 10-14-83

Depth of hole: 60' 6"

Length of well: 28'

Length of screen: 20'

Well yield: _____

Revert used: _____

Total footage drilled today: 506'

Mileage				
State	<u>WV</u>			

Fuel Supplied By:(check one)

☒ Driller

☐ Contractor

WELL LOG

Depth	Formation	Depth	Formation
0'-1'	T.P. SOIL		
1'-6'	FINE-MED. BRN. SAND		
6'-12'	MED-FINE BRN. SAND		
12'-18'	COARSE-MED. BRN. SAND		
	TRACE OF GRAVEL		
18'-24'	FINE-MED. BRN. SAND		
	TRACE OF GRAVEL		
24'-30'	MED-COARSE SAND		
30'-44'	MED-COARSE SAND		
	TRACE-FINE GRAVEL		
44'-48'	COARSE-MED BRN. SAND		
48'-56'	MED-COARSE TAN SAND		
56'-60'	MED-COARSE TAN SAND		
	TRACE FINE GRAVEL		
	LENSES GRAY CLAY		

M. Watters

Driller

[Signature]

Verified Contractor

NLI 001 0412

EXHIBIT C
OBSERVATION WELL LOGS

Geraghty & Miller, Inc.

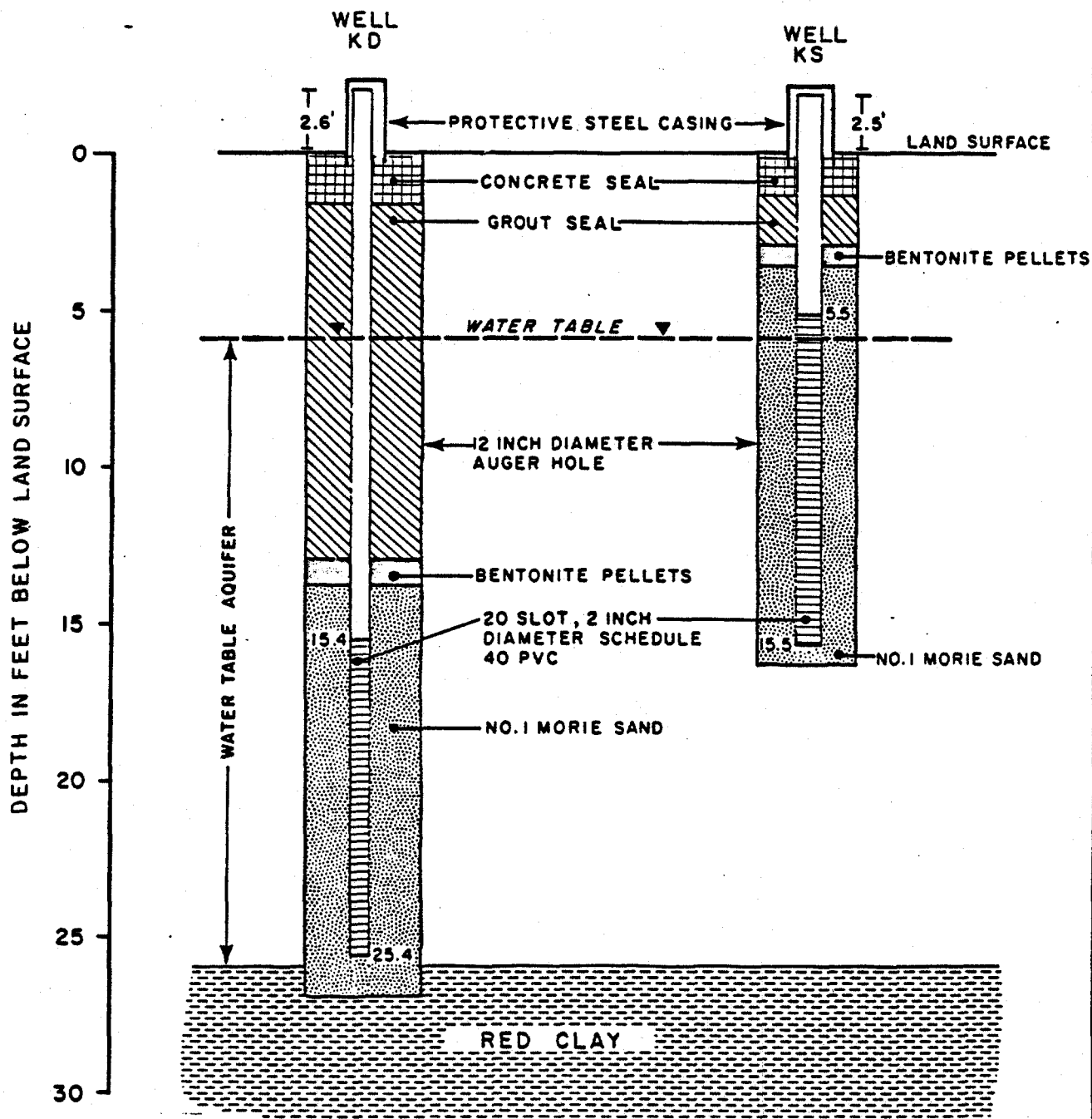
Installation of Observation Wells

During the field investigation, 28 observation wells were screened in the water-table aquifer, and two deep wells were screened in the first artesian aquifer to determine hydrogeologic conditions. Figure 1 is a map of the plant site showing well locations and lines of section. Figure 2 shows the construction details of a typical well cluster screened in the upper and lower zone of the water-table aquifer. Tables 1 and 2 provide construction details of the monitoring and observation wells. Geologic logs of the observation wells are included in Appendix A.

Testwell Craig Test Boring Company of Mays Landing, New Jersey, installed the wells with a power auger under Geraghty & Miller, Inc.'s direction. At each location, a 12-inch diameter hole was drilled to the required depth with split spoon samples collected at 5-foot intervals in wells completed in the lower water table zone. Shelby tube samples were collected from the confining clay layer, separating the water-table aquifer and the first artesian aquifer, at well locations T4 and 10. The results of laboratory permeability determinations of these samples are provided in Appendix C. The elevation of each well (top of PVC casing) was surveyed and converted to mean sea level by Albert A. Fralinger, of Bridgeton, New Jersey.

Excerpted from:

Geraghty & Miller, Inc., "Hydrogeologic Study and Design of Groundwater Abatement System at NL Industries, Inc. Pedricktown, New Jersey Plant Site," May 1983.



SUBJECT

TYPICAL OBSERVATION WELL CLUSTER
SCREENED IN WATER TABLE AQUIFER

PREPARED FOR

N.L. INDUSTRIES, INC.
PEDRICKTOWN, N.J.

Geraghty
& Miller, Inc.

COMPILED BY B. CARPENTER
PREPARED BY R. PADULA
PROJECT MGR K. ATOBRAH

SCALE
SHOWN
DATE
4-83

FIGURE
2

Geraghty & Miller, Inc.

Table 1. Construction Details of Official Monitoring Wells at
NL Industries, Pedricktown New Jersey, Plant Site.

Well No.	Elevation of Measuring Point (feet above mean sea level)	Total Depth Drilled (feet below land surface)	Screened Interval (feet below land surface)	Height of Measuring Point (feet above land surface)	Screen Slot Size (thousandths of an inch)
1R	13.32	35.5	4 - 32	4.0	20
2R2	9.14	25	13 - 20	2.2	20
3R	14.10	33	4 - 33	2.7	20
4R	14.80	29	9 - 21	2.7	20
5R	10.03	35.5	7 - 16	2.0	20
6	12.23	21.5	11 - 21	2.5	40
8R	16.55	124.5	101 - 108	2.9	18
9R2	16.73	73	53 - 61	2.8	18
AR	11.39	34.5	2.5- 32.5	2.5	20
BR	8.88	45	31 - 37	2.3	18
CR2	15 96	45	25 - 31	2.8	20
10	13.72	82	42.0-72.0	2.0	20
11	9.25	59	33.2-53.2	1.8	20

Note: All wells are 4-inch diameter.

Geraghty & Miller, Inc.

Table 2. Construction Details of Observation Wells Installed in November-December 1982, at NL Industries, Pedricktown, New Jersey Plant Site.

Well No.	Elevation of Measuring Point (feet above mean sea level)	Total Depth Drilled (feet below land surface)	Screened Interval (feet below land surface)	Height of Measuring Point (feet above land surface)
HD	16.73	41	23.8 - 38.8	2.6
HS	16.83	25	9.4 - 24.4	2.6
ID	15.24	42	18.6 - 33.6	2.6
IS	15.41	16	5.5 - 15.5	2.5
JD	12.08	27	15.1 - 25.1	2.9
JS	11.95	15	4.4 - 14.4	2.6
KD	10.70	29	15.4 - 25.4	2.6
KS	10.51	16	5.5 - 15.5	2.5
LD	10.89	19	9.7 - 16.7	2.3
LS	10.74	11	3.9 - 10.9	2.1
MD	8.37	19	9.6 - 17.6	2.0
MS	9.83	10	3.2 - 10.2	2.8
ND	10.35	22	11.9 - 21.9	2.1
NS	11.30	14	4.2 - 14.2	2.6
OD	11.44	37	19.5 - 34.5	3.0
OS	10.92	20	3.8 - 18.8	2.2
PD	10.25	30	16.8 - 26.8	3.2
PS	9.14	18	7.9 - 17.9	2.1
QD	10.19	25	11.5 - 21.5	2.5
QS	10.52	13	2.4 - 12.4	2.6
RD	13.62	41	25.0 - 35.0	2.0
RS	13.84	20	5.0 - 20.0	2.0
SD	11.45	30	15.0 - 27.0	2.5
SS	10.76	15	5.0 - 15.0	2.0
T2	11.34	27	7.6 - 22.6	2.4
T4*	11.09	23	8.0 - 23.0	2.0

*) 4-inch diameter schedule 80 PVC screened with 20 slot.

Geraghty & Miller, Inc.

Description	Depth (feet below land surface)	Thickness (feet)
Well HD		
Sand, brown, fine; with silt	0 - 4	4
Sand, gray-white, fine to medium; with silt	4 - 7	3
Silt, gray-white; with lenses of pink-red, white, mottled silty clay, gray-white silty fine sand and red-brown silty fine sand	7 - 21.5	14.5
Sand, yellow-brown, fine; with silt	21.5 - 29	7.5
Sand, gray-white, fine to medium; with silt and occasional gray silty clay lenses	29 - 38	9
Silt, gray-white, brown, mottled; with clay	38 - 41	3
Well ID		
Sand, brown, fine; with silt	0 - 3	3
Sand, light brown, fine; with silt and lenses of fine silty sand	3 - 8	5
Sand, gray-white, fine to medium; with silt	8 - 11.5	3.5
Silt, dark gray; with clay and lenses of fine sand	11.5 - 19	7.5
Sand, gray-white, fine to medium	19 - 24	5
Sand, gray-white, fine to coarse; with some silt and clay	24 - 28	4
Sand, gray-white, fine to medium; with some silt and clay lenses	28 - 37.5	9.5
Clay, red-pink and brown, mottled; with silt	37.5 - 41.5	4

Geraghty & Miller, Inc.

Description	Depth (feet below land surface)	Thickness (feet)
Well JD		
Sand, light brown, fine to medium	0 - 4	4
Sand, gray-white, fine to medium; with silt and occasional lenses of clayey sand	4 - 9	5
Sand, gray-white, fine to coarse; with silt, and occasional lenses of sandy clay	9 - 20	11
Sand, gray-white, fine to coarse; with silt, occasional lenses of sandy clay and fine gravel	20 - 23	3
Sand, white, brown, mottled, very fine; with clay, and lenses of sandy clay, with silt	23 - 25	2
Clay, red-pink, white, mottled; with silt	25 - 27	2
Well KD		
Silt, dark brown; with fine sand and organic matter	0 - 5.5	5.5
Sand, gray, fine; with some silt	5.5 - 8.5	3
Sand, gray-white, fine to coarse; with a lense of green-brown mottled very fine clayey sand with some silt	8.5 - 18	9.5
Sand, gray-white, fine to medium; with occasional lenses of sandy silt	18 - 26.5	8.5
Clay, red-pink, white, mottled; with some silt	26.5 - 29	2.5
Well LD		
Topsoil	0 - 0.5	0.5
Sand, light brown, fine	0.5 - 4	3.5
Sand, brown, fine; with some silt	4 - 9	5
Sand, gray-white, fine to medium; with silt and lenses of sandy clay	9 - 17	8
Clay, red-pink, brown, white, mottled; with some silt	17 - 19	2

<u>Description</u>	<u>Depth (feet below land surface)</u>	<u>Thickness (feet)</u>
Well MD		
Topsoil	0 - 0.5	0.5
Sand, light brown, fine; with silt	0.5 - 6	5.5
Silt, gray; with very fine sand and some clay	6 - 10.5	4.5
Sand, brown, fine; with silt	10.5 - 14	3.5
Sand, yellow-brown, fine to medium; with some silt	14 - 17	3
Silt, red-pink; with some clay and very fine sand	17 - 19	2
Well ND		
Topsoil	0 - 0.5	0.5
Sand, light brown, fine to medium; with a trace of silt	0.5 - 5	4.5
Sand, gray-brown, fine to medium; with a trace of silt	5 - 9	4
Sand, gray-white, fine; with silt and clay and lenses of sandy clay	9 - 14	5
Sand, gray-white, fine to coarse; with silt and clay and occasional lenses of sandy clay	14 - 21.5	7.5
Clay, red-pink and white, mottled; with silt	21.5 - 22	0.5
Well OD		
Topsoil	0 - 0.5	0.5
Sand, light brown, fine to medium; with some silt	0.5 - 7.5	7
Sand, brown, fine to coarse; with a gray-violet silt lense	7.5 - 11.5	4
Sand, gray-white, fine to medium; with some silt and occasional lenses of sandy clay	11.5 - 24	12.5
Sand, gray-white, fine to coarse; with some fine gravel and lenses of sandy clay	24 - 35.5	11.5
Clay, red-pink; with some silt	35.5 - 37	1.5

<u>Description</u>	<u>Depth (feet below land surface)</u>	<u>Thickness (feet)</u>
Well PD		
Topsoil	0 - 0.5	0.5
Sand, brown, fine to medium; with silt	0.5 - 3	2.5
Silt, gray; with very fine sand and some clay	3 - 4.5	1.5
Sand, brown, fine to medium; with silt and a lense of coarse sand with occasional fine gravel	4.5 - 9	4.5
Sand, red-brown, medium to coarse; with lenses of sandy clay	9 - 15.5	6.5
Sand, gray, fine to medium; with a trace of fine gravel	15.5 - 19	3.5
Sand, white-gray, fine to medium; with silt and occasional lenses of clayey silt with fine sand	19 - 28	9
Clay, red-pink, white, mottled	28 - 30	2
Well QD		
Sand, brown, fine to medium; with silt	0 - 8	8
Sand, gray-white, fine to medium; with silt	8 - 14	6
Sand, gray-white, fine to coarse; with silt	14 - 22	8
Clay, red-pink, white, mottled; with silt	22 - 25	3
Well RD		
Topsoil	0 - 0.5	0.5
Sand, light brown, fine to medium; with a trace of silt	0.5 - 9	8.5
Sand, gray, fine to medium; with a trace of silt	9 - 16.5	7.5
Clay, gray; with some silt and occa- sional lenses of fine silty sand	16.5 - 34	17.5
Silt, red, with some white mottling; sand, very fine and some clay	34 - 40.5	6.5

Description	Depth (feet below land surface)	Thickness (feet)
Well SD		
Sand, brown very fine; with some silt, trace of clay	0 - 3	3
Sand, brown, fine to medium; with some silt, plastic debris from battery casing	3 - 14	11
Sand, gray-white, fine to coarse; with silt	14 - 20	6
Sand, gray-white, fine to coarse; with occasional lenses of silty clay	20 - 28	8
Clay, red-pink, white, mottled; with some silt	28 - 30	2
Well T2		
Fill, sand, brown, fine to medium; silt, black, with plastic pieces from batteries	0 - 3	3
Sand, brown, fine to medium	3 - 9	6
Sand, gray, fine to medium; with some silt and a trace of fine gravel	9 - 14	5
Sand, gray, fine; with some silt and a trace of fine gravel	14 - 22	8
Sand, gray-white, fine to coarse; with some fine gravel	22 - 23	1
Clay, red-pink, white, mottled; with silt	23 - 27	4

EXHIBIT D

NSNJ Pedricktown
Landfill Leachate

Parameter	Phase "A" Primary Sump		Phase "B" Primary Sump		Phase "A" Secondary Sump		Phase "B" Secondary Sump	
	n	Max	n	Max	n	Max	n	Max
Antimony Sb	7	6.6	7	0.48	1	0.49		
Arsenic As	3	38.3	1	227	1	0.006	7	0.49
Arsenic Filt.	2	2.7	1	72.1	1	0.007	1	91.7
Barium Ba	1	1					1	60.6
Cadmium Cd	4	0.31	1	0.06	1	0.01	1	0.06
Cadmium Filt.	2	0.3	1	0.05	1	0.01	1	0.05
Chloride Cl	7	19300	7	630	1	164	6	525
Iron Fe	8	12300	7	184	1	1.1	7	9.5
Iron Filt.	1	8100						
Lead Pb	9	12.3	8	24.6	2	0.49	8	2.95
Lead Filt.	1	0.04	1	0.38	1	0.5	1	0.33
Manganese Mn	4	15.8	1	7.5	1	23	1	0.67
Manganese Filt.	2	13	1	0.07	1	22	1	0.67
Selenium Se	4	0.27	1	0.58	1	0.009	1	0.75
Selenium Filt.	2	0.041	1	0.44	1	0.011	1	0.61
Sulfate SO4	4	39100	1	20000	1	2730	1	33300
Tin Sn	6	13	7	1.4	1	0.5	7	2
T.O.C.	1	150	1	2170	1	27	1	2520
B.O.D.	6	9200	7	210	1	3	7	6
C.O.D.	6	17100	7	560	1	49	7	97
Hardness	6	584	7	1625	1	790	6	1100
pH	10	12.7(1.7)	8	11 (4.6)	2	6.3(5.2)	8	9.4(5.3)
Phenols	6	16.1	7	0.78	1	0.002	7	0.128
T.D.S.	10	169000	8	66400	2	4300	8	64700
Turbidity	10	920	8	250	2	31	8	170

Notes:

- If two pH values are recorded, the first value is the maximum pH and the second, in parentheses, is the minimum value.
- Samples collected by NL Industries, Inc.; analysis conducted by Century Environmental Labs, Inc., Thorofare, NJ.

EXHIBIT E

Geraghty & Miller, Inc.

Table 3. Summary of Water-Level Elevation Data, NL Industries, Pedricktown, New Jersey.

Well No.	Elevation of Measuring Point	Water-Level Elevation (feet above or below mean sea level)						
		12-9-82	12-15-82	12-21-82	12-28-82	1-6-83	1-11-83	3-8-83
1R	13.32	4.60	4.56	4.87	4.84	4.89	5.22	6.27
2R2	9.14	2.31	2.32	2.48	2.50	2.58	2.71	3.22
3R	14.10	2.83	2.85	3.02	3.03	3.09	3.20	-
4R	14.80	3.08	3.06	3.24	3.27	3.23	3.28	4.21
5R	10.03	3.39	3.33	3.65	3.57	3.87	4.36	5.77
6	12.23	3.77	3.74	3.96	3.91	4.03	4.36	4.78
8R	16.55	-8.63	-6.38	-8.35	-8.49	-6.95	-7.82	-2.99
9R2	16.73	-3.52	-2.77	-3.42	-3.25	-2.60	-3.01	6.50
10	13.72	-2.68	-2.30	-2.48	-2.23	-2.18	-2.27	-2.00
11	9.25	4.77	3.80	4.00	4.04	4.17	4.37	5.01
AR	11.39	4.14	4.13	4.36	4.39	4.44	4.62	6.45
BR	8.88	3.46	3.46	3.66	3.68	3.83	3.99	4.68
CR2	15.96	2.75	2.88	3.07	3.27	3.39	3.39	-
HD	16.73	2.75	2.86	3.04	3.25	3.37	3.38	-
HS	16.83	2.78	2.87	3.05	3.26	3.36	3.37	-
ID	15.24	4.05	4.04	4.24	4.35	4.34	4.45	6.39
IS	15.41	6.42	6.46	6.68	6.82	6.82	6.99	9.74
JD	12.08	4.29	4.20	4.55	4.48	4.54	4.86	6.58
JS	11.95	4.29	4.24	4.57	4.54	4.57	4.88	-
KD	10.70	3.98	3.98	4.22	4.22	4.31	4.57	6.08
KS	10.51	4.06	4.09	4.31	4.32	4.38	4.66	6.18
LD	10.89	3.76	3.74	4.06	4.00	4.00	4.23	5.53
LS	10.74	3.81	3.77	4.14	4.09	4.08	4.40	5.84
MD	8.37	2.45	2.51	2.69	2.70	2.77	2.88	3.51
MS	9.83	2.54	2.56	2.71	2.73	2.82	3.07	3.55
ND	10.35	3.15	3.09	3.32	3.27	3.41	3.62	4.23
NS	11.30	3.17	3.14	3.37	3.33	3.44	3.63	4.30
OD	11.44	3.46	3.44	3.65	3.58	3.74	4.09	4.51
OS	10.92	3.58	3.54	3.78	3.71	3.84	4.22	4.70
PD	10.25	3.63	3.65	3.80	3.80	3.92	4.11	4.72
PS	9.14	3.63	3.65	3.80	3.80	3.93	4.12	4.72
QD	10.19	3.89	-	4.17	4.14	4.24	4.57	5.48
QS	10.52	3.96	3.94	4.19	4.19	4.27	4.61	5.54
RD	13.62	4.33	4.90	5.09	5.23	4.74	4.66	6.88
RS	13.84	5.68	5.64	5.91	5.99	5.99	6.22	7.46
SD	11.45	3.66	3.72	3.92	3.97	3.83	4.07	5.29
SS	10.76	3.90	3.89	4.08	4.14	4.17	4.38	-
T2	11.34	3.79	3.77	4.00	3.97	4.05	4.39	5.42
T4	11.09	3.77	3.79	3.99	3.94	4.01	4.37	5.06

Note: All wells measured from top of PVC

Excerpt from: Geraghty & Miller, Inc. May 1983. "Hydrogeologic Study and Design of Groundwater Abatement System at NL Industries, Inc. Pedricktown, New Jersey Plant Site."